JOURNAL OF CYCLE RESEARCH

Vol. 10, No. 4

October 1961

JOURNAL OF CYCLE RESEARCH

Vol. 10, No. 4 October 1961

Contents

Editorial

The Rôle of the Foundation for the Study of Cycles — Page

by Edward R. Dewey 97

Wheeler's Indexes of War 99

The Foundation for the Study of Cycles'

Directory of Cycle Scientists 103

Testing Cycles for Statistical Significance

by Charles E. Armstrong 119

The Average Latitude of Sunspots

by Edward R. Dewey 125

Journal of Cycle Research is published quarterly in January, April, July, and October of each year by the Foundation for the Study of Cycles at East Brady, Pennsylvania. The subscription rate is $4.00 a year. Single copies are $1.00 each. Entered as second class matter at the post office at East Brady, Pennsylvania with additional entry at Dexter, Michigan. Publication office, 680 West End Avenue, New York 25, New York

Digitized by the Internet Archive
in 2023

https://archive.org/details/journal-of-cycle-research_1961-10_10_4

EDITORIAL

THE RÔLE OF THE FOUNDATION FOR THE STUDY OF CYCLES

RHYTHMIC or cyclic fluctuation characterizes the phenomena of 36 separate disciplines. Astronomy, physics, astro-physics, seismology, volcanology, sedimentary geology, hydrology, oceanology, bacteriology, limnology, ichtheology, mammalogy, ornithology, entomology, climatology, glaciology, terrestrial magnetism, medicine, physiology, botany, dendrochronology, agronomy, history, sociology, and economics are examples. More than 2500 scientists have aluded to rhythmic fluctuations, have alleged it, and/or have studied it.

Rhythmic Fluctuations

Rhythmic (cyclic) fluctuation is the name given to those variations in size, in number, or in quality that recur with reasonable regularity—that is, with a beat. The tides are rhythmic. So are the seasons. So are the numbers of certain animals. So are the variation in the number of sunspots. So are brain waves.

For the most part those scientists who have aluded to rhythmic fluctuations have assumed that the rhythms referred to were significant—that is, that they had a non-chance cause. This assumption has not always been justified. Rhythm can be found even in a series of random numbers. It follows that the rhythms observed in natural and social phenomena are often random too.

However, some rhythms are so regular and/or so persistent that chance alone is not an adequate explanation for the behavior. The 11-year rhythm of sunspot numbers is an example; so is the well established 9.6-year rhythm in the abundance of the varying hare and other north-latitude mammals. Some non-chance cause is particularly implied when, as so often happens, the rhythm continues after discovery.

Cause

In searching for cause, the tendency of scientists has been to assume a cause within the discipline of the phenomenon itself. The biologist seeks a biological cause, the geologist seeks a geological cause, the climatologist seeks a climatological cause. This, at least in the first instance, is as it should be.

However, it so happens that when the results of the research of various scientists are tabulated we find scores—perhaps hundreds—of instances where a rhythm discovered by one man in the data of one discipline has a wave length that seems to be exactly equal to the wave length of a rhythm discovered by someone else in the data of another discipline. Moreover, it is usual for these rhythms of seemingly identical wave length to crest (and trough) at more or less the same calendar time.

Interdiscipline Relationships

These facts suggest that *if* the wave lengths of the rhythms are really identical there may be an inter-discipline relationship or perhaps a more fundamental cause that lies behind the behavior of both disciplines.

But are the wave lengths identical? We have records of a "ten-year" rhythm in the abundance of Canadian lynx and of a "ten-year" rhythm in the outbreaks of plagues of grasshoppers. However, more careful measurement shows clearly that the "ten-year" lynx rhythm is 9.6 years long, the "ten-year" grasshopper rhythm is 9.2 years long. It follows that there is no possible interrelationship. Starting out together, the two rhythms will gradually pull apart until, after a few repetitions, one is upside down in relation to the other. In other instances, to the contrary, more and more careful measurements tend to confirm, rather than to deny, the suggested identity of wave length.

A Program

It follows that, to meet this situation, several things are needed. Among them,—

(1) More accurate measurement of rhythm length, strength, shape, and timing.

(2) Room in our thinking for the concept of irregular rhythms.

(3) More complete reporting of the measurement processes so that qualified workers can evaluate the methodology and the conclusions reached.

(4) Some sort of an interdiscipline clearinghouse, so that students of rhythm in one discipline can know the other disciplines where "their" wave lengths have been discovered. A full knowledge of the other manifestation of the rhythm is necessary if the workers in each discipline are to formulate adequate theories of cause and effect. (The great British physicist Tyndall once said, "An idea in an empty head has the time of its life. It can rotate in any orbit it chooses without having any facts to bump into.")

Such a clearinghouse should publish and keep up to date a cyclopedia of rhythmic cycles, cross indexed by discipline and by wave length, a directory of cycle research scientists, and a medium for the publication of scientific papers in this field.

The Foundation for the Study of Cycles

The Foundation for the Study of Cycles can make an important contribution to such a program. The foundation can help scientists to appreciate the fact that more precise information about rhythmic fluctuation is necessary. It can help scientists and others to a knowledge of the necessary techniques. It can promote the proper reporting of cycle investigations.

The essence of good cycle reporting involves a presentation of (a) the unmanipulated data, with notes as to source; (b) the recording of wave lengths and other cycle characteristics with the greatest possible precision; (c) the reporting of all the manipulation and/or methods used to detect, isolate, and evaluate the rhythm. This reporting should include work charts, and if possible, work sheets for the entire analysis.

Too often we read, for example, "I have discovered a ten-year cycle in the abundance of grasshoppers." In contrast, good cycle exposition required the author to say, "I have discovered a 9.2.year (±.1-year) cycle in the abundance of grasshoppers in the United States, 1841—1940, Here are my data. Here, so that the reader can see if he approves, are my methods; here are my work charts; here are all pertinent work sheets. Crests of the idealized cycle come at 1847.2 and at 9.2-year intervals forward from that time. The current crest of the idealized cycle is due at 1957.6. The waves have a typical strength of 239% of trend at time of crest, 42% of trend at time of trough. They account for 52% of the variation from trend. Their shape is zigzag. They have repeated 10½ times in the available data. Trend was determined in such and such a way. Here is my evaluation of the significance of this cycle."

Nothing less than this is an adequate investigation. Nothing less than this is an adequate presentation. To the furthering of such research and such reporting, the foundation is dedicated. *E.R. Dewey*

WHEELER'S

INDEXES OF WAR

The indexes of war presented herewith were prepared by Raymond H. Wheeler, at the time Professor of Psychology at the University of Kansas. They are the result of a search of all available literature.

There are three indexes, one for international conflict, one for civil conflict, and a third obtained by adding the first two.

Professor Wheeler prepared his indexes as follows: to a mild engagement he gave a value of one, to a moderately severe engagement he gave a value of two, and to a very exceptionally heavy engagement he gave a value of three. The value of the index for any particular year is the summation of the values so determined.

The values for World War I and World War II years are somewhat arbitrary.

Note that as there is no zero year, negative years differ from B.C. years by one. That is, year 600 B.C. is year minus 599, and so on.

E. R. D.

INDEX OF CIVIL WAR BATTLES, 600 B.C. (-599) – A.D. 1957

* Zero Year is the Year 1 B.C.

Years Before Base Year (-)	Minus Base Years					
	-500	-400	-300	-200	-100	*0
0	8	2	9	1	1	0
1	3	4	2	2	2	1
2	0	1	1	0	10	0
3	0	3	0	0	1	0
4	0	3	2	0	2	1
5	2	4	2	1	3	0
6	0	1	3	3	0	2
7	2	0	0	1	4	1
8	4	3	0	1	3	9
9	5	5	1	1	4	2
10	11	7	3	0	2	5
11	0	2	6	0	1	3
12	2	3	0	0	5	2
13	2	1	2	8	0	1
14	5	2	3	0	0	0
15	2	2	3	5	0	6
16	0	1	7	4	0	2
17	3	2	4	6	0	0
18	0	1	3	2	3	0
19	5	0	1	2	0	1
20	1	0	3	0	2	0
21	2	3	2	8	7	0
22	3	2	4	1	1	1
23	0	5	0	0	4	0
24	0	6	0	1	1	2
25	0	3	2	1	9	1
26	0	4	1	3	3	0
27	1	3	0	0	0	0
28	0	2	0	1	2	1
29	1	0	2	0	7	2
30	1	0	2	0	0	9
31	0	1	0	5	1	4
32	0	2	0	2	4	2
33	1	0	0	0	7	0
34	0	0	1	0	7	3
35	0	0	3	0	7	7
36	0	0	2	4	0	0
37	1	0	0	4	1	4
38	1	1	0	5	0	3
39	1	3	2	2	1	0
40	2	2	1	4	2	0
41	0	0	1	4	2	5
42	0	0	5	0	1	4
43	0	0	6	3	1	3
44	0	2	3	2	1	4
45	0	0	1	0	2	7
46	0	0	1	1	2	2
47	0	2	3	2	2	3
48	2	1	6	0	0	5
49	2	2	4	1	1	8
50	2	2	5	4	0	4
51	0	0	3	0	0	10
52	2	0	1	0	2	9
53	2	1	2	0	7	5
54	2	3	1	1	2	0
55	2	0	3	0	0	0
56	3	0	3	0	0	1
57	0	1	3	0	0	0
58	0	1	1	0	2	2
59	2	2	0	0	1	3
60	1	6	1	1	2	0
61	6	2	0	0	1	1
62	0	2	2	3	1	2
63	0	1	0	0	3	3
64	0	2	1	2	4	0
65	0	4	2	2	7	0
66	0	1	0	0	0	1
67	2	2	1	1	3	1
68	1	2	2	0	1	0
69	0	3	2	1	2	1
70	0	1	3	0	7	1
71	2	2	1	0	2	0
72	0	1	2	0	0	6
73	0	2	0	0	1	1
74	0	1	0	1	0	0
75	0	2	5	0	2	2
76	0	0	1	1	3	0
77	0	1	1	0	3	4
78	0	1	1	3	4	4
79	0	3	1	2	2	2
80	0	0	0	3	2	4
81	2	1	0	2	0	0
82	2	0	3	4	5	12
83	1	2	2	0	1	5
84	2	2	0	1	4	1
85	1	2	1	2	6	0
86	0	4	0	2	1	5
87	0	3	2	2	0	6
88	0	1	0	4	4	5
89	2	4	1	0	1	3
90	4	1	3	3	0	7
91	0	2	2	2	0	1
92	1	7	0	0	0	0
93	3	3	0	1	0	0
94	2	3	2	2	0	0
95	4	6	2	5	0	3
96	2	3	1	1	1	0
97	2	2	1	0	0	2
98	2	3	1	4	2	0
99	1	5	1	0	0	4

Years After Base Year	Base Years A.D.																			
	*0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
0	*	2	8	1	6	4	3	1	6	12	10	7	7	13	14	5	15	2	5	19
1	2	2	0	0	4	6	1	2	4	1	2	12	7	9	6	4	16	6	7	11
2	0	0	0	1	4	4	4	2	6	4	9	7	8	15	6	4	4	4	4	12
3	4	0	0	2	6	1	2	2	3	1	4	12	13	8	17	0	7	9	13	9
4	3	0	0	3	3	0	1	0	5	0	5	9	13	12	6	1	5	11	11	9
5	1	2	2	0	4	2	2	5	2	3	6	8	13	10	11	2	3	11	4	13
6	10	4	0	5	12	0	0	0	5	1	2	8	17	17	13	1	3	7	13	9
7	4	4	1	4	8	8	0	0	1	0	1	10	5	9	8	3	4	15	9	15
8	7	0	5	4	6	4	2	0	0	5	2	8	5	8	10	7	1	14	6	17
9	8	1	0	0	12	0	1	8	1	1	3	12	10	5	8	0	2	7	11	12
10	0	0	0	1	5	0	3	8	9	1	4	2	4	14	19	6	2	4	14	14
11	0	0	2	3	3	4	0	11	3	0	2	9	12	10	12	7	2	10	11	20
12	0	0	2	5	3	4	0	8	2	1	2	6	10	12	8	6	1	11	10	24
13	0	4	7	3	2	1	0	2	2	2	5	10	9	12	13	6	1	9	8	18
14	2	2	1	3	3	0	0	5	2	1	11	6	8	13	5	9	3	6	14	9
15	3	1	1	5	2	5	0	9	1	2	11	6	8	18	4	12	5	10	14	4
16	5	2	1	1	1	1	0	2	0	1	9	3	7	15	0	13	0	6	12	5
17	2	2	2	2	0	0	1	8	4	1	3	8	11	16	2	12	2	9	12	12
18	2	0	6	1	0	2	1	3	2	0	4	9	8	11	1	10	5	5	13	14
19	3	1	2	1	3	0	3	4	0	2	4	6	15	6	3	12	9	6	5	33
20	1	0	4	0	1	2	0	5	2	1	1	7	12	6	8	11	11	3	18	30
21	4	1	3	0	0	0	0	6	8	5	2	4	16	6	11	17	14	1	22	33
22	2	0	1	2	4	0	0	4	7	6	1	6	7	8	8	6	11	4	16	31
23	3	0	0	6	0	2	4	1	9	6	1	9	9	7	3	7	12	5	11	8
24	2	0	1	3	0	0	3	4	5	5	1	2	8	10	5	10	5	5	5	27
25	2	0	2	0	0	4	3	4	2	2	2	7	7	11	6	5	2	0	10	14
26	2	1	3	0	0	2	5	4	3	11	6	8	4	11	9	6	4	0	10	15
27	0	0	0	0	0	2	4	5	6	9	2	7	12	12	12	2	5	2	12	20
28	1	0	1	0	0	3	5	7	2	12	8	4	11	9	9	3	6	0	15	16
29	0	1	0	0	0	1	4	11	2	14	1	2	8	1	6	1	3	2	11	22
30	0	0	0	1	0	3	5	5	3	16	10	5	9	8	15	1	10	5	24	26
31	0	2	1	0	0	6	2	3	8	10	7	1	11	3	16	10	7	3	24	20
32	0	3	0	0	2	7	3	10	11	11	8	6	5	7	7	4	10	3	25	9
33	0	2	0	0	0	0	2	1	12	17	6	2	10	9	6	1	3	6	13	5
34	0	2	1	0	0	3	8	0	5	14	8	1	14	5	10	4	8	6	14	12
35	0	5	2	1	0	3	5	0	10	11	10	3	9	10	12	6	3	3	7	11
36	2	2	0	1	0	2	5	0	5	5	6	12	11	15	6	5	3	8	6	12
37	0	2	1	2	0	0	4	2	8	11	9	6	7	13	6	12	15	9	18	15
38	2	0	3	2	0	0	5	2	6	2	10	12	16	8	9	5	12	5	15	17
39	1	0	0	1	0	1	5	2	4	9	11	14	9	10	11	6	8	12	26	10
40	0	0	1	3	0	0	7	9	16	12	12	11	11	17	10	5	10	9	20	6
41	2	2	0	0	1	3	9	11	14	12	6	9	16	5	9	7	6	7	19	3
42	2	1	1	1	0	0	9	6	8	6	12	10	3	4	6	10	8	5	17	2
43	0	0	0	0	2	0	6	9	4	7	10	7	4	7	6	5	7	3	20	2
44	3	0	1	0	0	0	3	2	6	7	3	7	7	1	4	5	14	5	17	2
45	0	1	0	3	1	2	8	8	5	6	4	9	6	6	7	8	8	8	9	2
46	3	0	0	0	5	0	4	4	8	10	4	11	5	8	6	16	8	4	9	51
47	0	2	0	0	0	0	6	3	8	15	8	20	7	16	11	14	8	12	12	35
48	1	2	4	0	8	0	6	2	5	9	3	7	6	14	8	8	20	5	35	26
49	1	0	3	0	6	1	4	5	5	5	5	10	2	9	6	10	9	5	29	33
50	2	0	0	2	2	12	3	8	7	7	8	13	6	9	3	2	12	2	13	30
51	0	0	2	2	10	0	5	6	5	8	7	5	4	5	10	4	15	3	13	13
52	0	1	0	2	3	2	2	5	10	6	8	8	6	7	5	2	11	4	9	16
53	0	0	6	5	4	1	2	5	5	2	5	13	3	9	8	4	7	2	7	25
54	0	0	2	1	6	2	1	13	3	6	11	7	9	9	6	3	5	1	7	23
55	1	2	5	2	3	11	2	7	11	8	8	10	8	8	11	2	4	5	6	25
56	0	1	0	0	6	2	3	14	3	4	2	9	6	8	11	3	7	8	5	54
57	0	0	1	9	5	4	2	1	3	5	5	13	12	6	5	3	0	1	14	69
58	2	0	3	9	1	5	4	10	5	6	2	14	5	14	13	6	4	6	13	
59	4	0	1	1	5	3	2	9	1	4	4	11	3	9	9	4	4	6	17	
60	0	2	0	2	0	1	0	5	13	8	4	16	5	7	5	5	4	6	20	
61	3	2	1	3	1	0	4	9	8	13	7	7	1	2	23	4	8	6	27	
62	1	0	0	3	0	3	2	5	12	15	7	9	6	9	22	4	19	6	21	
63	0	0	2	3	1	0	3	7	6	9	5	8	6	5	13	8	11	13	37	
64	2	0	0	4	2	0	0	5	6	11	11	11	3	0	12	3	9	12	35	
65	2	8	1	1	0	0	2	5	4	5	8	5	3	6	13	15	7	5	23	
66	3	4	1	8	2	8	0	4	10	20	9	4	7	5	19	17	13	9	30	
67	3	0	5	8	2	2	0	5	11	4	3	5	5	5	18	17	8	9	28	
68	8	3	3	4	7	12	5	4	3	11	8	4	8	5	18	18	5	12	30	
69	8	1	3	1	0	5	0	3	0	8	7	3	6	9	10	15	12	6	15	
70	4	2	5	1	2	2	3	3	7	5	7	3	2	3	14	14	11	10	11	
71	1	1	9	0	3	0	7	5	20	2	11	6	5	5	17	11	7	9	6	
72	0	2	4	0	4	2	5	2	9	3	7	2	6	1	8	17	13	6	4	
73	1	1	6	0	3	0	2	2	4	13	12	7	5	4	8	15	1	10	8	
74	0	3	3	1	0	2	1	5	2	10	2	13	4	3	12	23	6	13	6	
75	0	2	1	2	1	2	2	3	6	13	4	11	6	7	11	12	2	16	5	
76	0	0	2	0	7	3	0	9	3	14	0	15	6	8	20	20	5	15	6	
77	1	1	3	0	5	4	3	1	9	9	3	10	8	13	17	13	0	6	5	
78	1	3	1	2	0	2	3	2	16	5	3	8	7	12	17	20	1	11	9	
79	0	6	2	1	3	1	9	2	5	6	1	5	7	15	7	18	3	15	8	
80	2	2	2	2	0	3	6	4	3	14	4	14	9	12	8	16	6	14	8	
81	1	0	0	0	3	5	9	0	3	16	7	14	10	14	15	7	3	16	19	
82	0	1	0	0	0	1	4	4	6	12	5	8	13	11	14	9	2	8	13	
83	0	4	2	1	0	1	7	1	3	12	1	10	11	11	9	11	14	5	15	
84	0	3	1	1	0	1	3	2	9	2	4	9	11	2	9	7	6	13	9	
85	1	1	2	0	0	2	6	6	6	12	4	12	8	10	15	8	9	11	18	
86	0	2	7	0	1	3	4	3	4	9	8	11	7	6	6	11	5	11	14	
87	0	0	3	2	0	3	5	4	9	14	0	7	5	6	7	12	5	15	7	
88	1	0	4	3	0	0	1	2	4	6	6	3	9	12	12	9	12	16	4	
89	2	4	1	4	0	1	1	5	4	6	1	5	9	8	8	6	9	19	15	
90	0	0	0	1	1	2	2	7	4	4	2	7	14	4	6	10	3	21	11	
91	0	2	1	2	0	1	2	3	5	6	4	7	10	8	5	10	5	11	8	
92	0	3	2	1	0	2	5	11	3	2	4	7	6	10	8	16	2	13	8	
93	0	3	1	0	7	0	3	3	3	2	9	9	10	12	2	11	2	8	21	
94	0	4	2	5	0	0	3	2	6	4	4	7	11	10	3	8	2	17	22	
95	3	0	3	3	0	0	3	4	9	13	8	7	9	5	3	12	4	15	13	
96	2	5	5	0	0	0	2	6	11	3	5	5	16	12	1	6	7	7	21	
97	2	4	0	3	3	0	9	5	2	11	8	15	12	3	3	10	0	9	19	
98	1	4	0	5	0	0	2	4	3	5	2	7	13	7	1	9	3	13	23	
99	1	2	0	0	0	2	1	10	3	8	10	7	14	15	5	17	5	3	19	

INDEX OF INTERNATIONAL BATTLES, 600 B.C. (-599) – A.D. 1957

* Zero Year is the Year 1 B.C.

Years Before Base Year (-)	Minus Base Years						Years After Base Year	Base Years A.D.																			
	-500	-400	-300	-200	-100	*0		*0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
0	0	6	0	6	5	0	0	*	0	0	1	2	3	2	1	0	8	7	2	0	0	4	17	15	5	21	5
1	0	4	0	5	3	0	1	0	2	0	0	0	0	0	0	4	3	8	3	2	1	4	9	6	13	27	10
2	0	1	0	0	2	0	2	0	1	0	0	0	1	2	0	2	0	4	1	4	0	7	9	6	22	18	5
3	0	2	0	1	3	0	3	0	0	0	0	0	0	2	0	4	0	6	0	4	1	1	7	7	11	19	6
4	0	6	0	1	3	0	4	0	0	0	0	0	0	2	0	4	3	6	0	1	0	2	7	1	21	12	14
5	0	8	0	4	0	0	5	0	1	0	0	0	3	0	6	3	3	4	2	2	0	1	6	2	9	24	8
6	0	3	0	3	1	0	6	1	1	0	2	0	0	0	0	0	2	0	0	4	0	1	8	3	15	29	2
7	2	6	0	2	7	0	7	0	0	0	0	0	6	2	0	0	8	0	0	0	2	1	4	4	15	26	3
8	1	6	0	7	3	0	8	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	7	5	16	29	4
9	2	3	2	4	6	0	9	0	0	1	1	0	0	6	1	4	0	4	2	2	0	0	12	4	19	28	1
10	1	6	2	3	7	0	10	1	0	0	1	1	0	4	2	3	4	7	0	11	4	10	2	4	13	28	1
11	1	0	1	3	2	0	11	0	0	0	0	0	0	2	5	3	7	0	0	8	5	2	2	12	7	24	2
12	1	3	0	2	0	0	12	0	0	0	2	0	0	0	4	4	1	2	0	11	0	0	17	7	5	25	8
13	0	10	0	2	0	0	13	0	0	0	0	0	0	3	2	5	3	2	1	5	1	2	12	15	0	38	8
14	0	10	0	1	3	0	14	1	1	0	0	2	0	2	2	0	9	6	0	4	0	0	5	8	7	40	73
15	0	6	1	3	3	0	15	0	0	0	1	2	0	5	6	1	4	9	4	3	0	9	4	12	5	31	73
16	0	4	1	4	0	1	16	0	2	0	0	1	0	6	1	0	1	12	1	6	0	2	5	6	8	5	71
17	0	0	1	6	2	0	17	0	3	2	3	1	0	0	3	0	2	9	0	0	1	8	1	9	7	3	73
18	0	3	1	3	1	0	18	1	0	0	1	1	0	0	0	2	2	8	2	6	3	4	1	5	4	4	73
19	3	0	0	3	1	1	19	0	0	0	1	1	0	7	0	0	1	6	4	9	2	7	4	3	7	0	18
20	1	1	0	3	4	0	20	0	0	0	0	6	0	2	0	0	1	0	3	8	4	11	7	4	10	5	25
21	3	1	0	1	1	0	21	0	0	0	0	1	0	6	0	0	4	2	0	2	0	5	16	15	3	4	19
22	2	0	2	3	2	4	22	0	0	2	0	1	0	6	0	0	0	4	6	6	0	11	13	9	4	4	12
23	0	2	0	2	1	1	23	0	0	0	0	2	0	4	0	0	6	2	4	5	7	4	9	12	9	7	9
24	2	2	0	3	0	2	24	0	0	1	0	0	0	1	0	0	2	4	9	8	0	4	10	12	2	8	1
25	3	2	2	3	0	0	25	0	0	0	0	3	0	0	1	0	0	0	7	7	2	1	13	14	1	3	6
26	4	1	2	3	0	0	26	0	0	2	0	1	2	7	0	1	1	4	10	6	2	1	20	19	0	13	8
27	2	0	1	0	0	0	27	0	0	1	0	0	1	8	0	0	2	2	9	13	6	2	20	14	3	13	5
28	2	3	5	0	0	0	28	0	0	0	0	5	3	2	0	0	3	6	7	6	3	4	14	7	0	20	4
29	1	2	3	4	0	0	29	0	0	1	0	9	4	6	1	0	1	5	5	0	7	6	16	5	0	11	4
30	2	4	6	0	2	0	30	0	0	1	0	6	1	3	0	2	4	7	4	2	7	0	5	9	1	7	10
31	0	3	6	0	2	2	31	0	1	1	0	0	11	0	1	0	1	8	0	1	5	0	6	15	1	6	8
32	0	2	4	0	0	0	32	0	0	2	1	1	7	4	2	0	0	0	0	4	0	0	8	8	1	5	13
33	0	1	5	0	0	0	33	1	0	1	0	4	7	6	0	2	0	3	0	2	0	0	9	4	0	1	8
34	1	2	3	2	0	0	34	0	0	0	0	0	11	1	0	0	4	1	0	2	0	0	7	10	10	0	4
35	1	0	3	0	0	0	35	0	1	1	0	4	7	2	0	0	0	3	3	1	2	0	9	14	1	0	12
36	1	0	0	0	0	0	36	0	0	1	0	0	4	4	0	0	0	0	2	0	7	2	7	8	9	1	8
37	1	0	4	1	1	1	37	0	0	1	2	5	2	4	0	0	0	0	0	6	10	0	7	7	3	1	15
38	2	0	1	0	2	1	38	0	0	2	4	0	0	4	0	4	0	9	0	4	5	2	9	10	5	1	27
39	3	0	2	0	1	0	39	0	0	0	0	3	7	2	0	0	2	2	3	8	3	0	6	10	9	4	41
40	3	2	3	5	0	0	40	2	1	1	1	0	4	4	0	0	0	1	0	18	6	2	11	5	3	2	33
41	0	0	1	1	0	1	41	0	0	1	0	2	6	5	0	0	2	0	0	11	6	1	4	5	8	1	150
42	1	0	2	0	0	0	42	0	5	0	0	7	0	3	0	1	0	0	0	2	2	2	10	11	8	1	150
43	1	0	3	0	0	0	43	3	0	0	0	0	3	0	0	0	0	2	0	1	2	5	3	10	8	1	150
44	0	1	1	0	2	0	44	0	0	2	0	0	0	4	0	0	4	2	0	4	4	6	3	5	9	0	150
45	3	1	1	2	4	0	45	2	0	0	1	1	2	0	1	0	2	0	0	8	3	0	1	10	17	3	150
46	5	1	0	1	6	4	46	1	0	0	4	1	10	0	0	0	0	0	0	3	4	3	1	6	14	8	1
47	0	2	2	3	2	2	47	0	0	0	0	4	1	2	0	1	0	0	6	6	6	0	0	2	15	10	0
48	0	4	1	0	2	0	48	0	0	0	4	2	0	0	0	0	0	0	0	5	2	5	3	14	6	19	0
49	4	5	1	3	0	0	49	0	0	1	0	4	14	0	0	0	0	0	0	2	2	8	1	1	2	18	0
50	2	3	0	3	4	3	50	0	3	2	5	1	0	0	0	1	0	0	0	6	6	7	1	10	8	3	15
51	0	0	0	0	2	2	51	0	0	2	1	10	1	0	0	0	0	0	0	1	3	6	7	8	7	4	12
52	0	0	2	0	0	3	52	0	0	0	0	4	12	0	0	1	0	0	0	4	2	8	16	8	4	5	0
53	0	0	1	2	0	2	53	0	0	1	0	4	8	0	0	0	0	0	0	6	6	6	3	13	4	19	2
54	0	3	2	2	3	4	54	0	0	0	0	0	8	0	3	0	0	0	0	9	6	5	2	11	5	18	2
55	2	2	3	3	0	2	55	0	0	0	0	4	2	0	2	0	0	0	0	1	2	2	2	15	13	16	3
56	0	6	1	3	0	5	56	0	0	0	0	2	0	0	2	0	0	0	0	2	4	7	10	22	18	15	12
57	0	3	2	0	0	4	57	0	2	2	0	0	0	0	0	0	0	0	0	0	4	3	15	17	21	11	5
58	0	4	1	0	0	0	58	1	0	4	0	0	0	0	4	0	0	0	0	12	3	0	11	20	19	10	-
59	0	2	3	2	1	2	59	0	0	3	5	2	0	4	0	0	0	0	0	0	4	0	4	9	16	20	
60	0	2	0	4	0	1	60	0	1	4	2	0	0	1	1	0	0	0	0	6	9	0	7	9	19	10	
61	0	2	4	3	0	1	61	0	0	0	0	0	0	0	0	0	0	0	1	10	13	2	9	4	14	6	
62	0	0	0	2	0	6	62	0	2	0	2	1	2	0	0	0	0	0	1	2	5	2	4	10	11	3	
63	0	2	2	2	1	2	63	0	0	2	6	0	1	2	1	0	0	0	0	4	8	0	7	6	2	4	
64	0	0	0	0	0	1	64	0	0	1	0	0	0	0	0	0	0	0	2	9	2	0	11	11	2	4	
65	0	4	1	0	0	2	65	0	0	2	1	0	0	0	0	0	0	0	0	6	3	0	13	8	0	3	
66	0	0	0	0	0	0	66	1	0	0	0	0	0	0	1	1	4	6	0	5	13	1	8	8	1	7	
67	0	2	2	0	2	4	67	0	0	0	1	0	0	0	0	0	0	0	2	2	2	0	8	15	0	0	
68	0	2	2	0	0	3	68	1	0	2	0	0	7	9	2	0	9	2	0	8	10	1	4	1	1	5	
69	0	3	5	1	0	0	69	2	0	2	0	2	3	0	0	0	5	2	2	8	5	2	4	6	6	2	
70	0	2	4	3	2	0	70	2	0	4	1	0	2	2	0	0	2	3	0	6	9	4	8	1	8	11	
71	0	1	2	3	0	0	71	3	0	3	0	1	1	0	0	0	8	8	0	4	7	2	8	8	7	7	
72	0	3	1	0	0	3	72	1	0	3	2	0	13	0	2	2	0	1	0	5	1	2	0	19	6	3	
73	0	2	0	3	0	1	73	3	0	2	1	0	7	0	3	0	4	6	0	14	2	0	1	22	1	6	
74	0	0	1	3	0	0	74	0	0	0	1	0	0	0	6	0	2	6	0	12	2	4	2	21	6	6	
75	0	4	2	0	1	1	75	0	0	2	8	0	8	0	0	0	1	4	1	6	8	4	3	24	2	5	
76	0	1	2	4	0	3	76	2	0	0	3	2	6	0	6	0	0	17	0	2	8	0	2	19	2	12	
77	0	4	2	5	0	0	77	0	2	0	2	0	4	2	6	2	0	8	1	11	2	1	1	24	2	12	
78	0	6	4	1	0	4	78	5	0	0	6	0	4	0	10	3	0	2	2	6	0	0	0	13	9	12	
79	0	9	4	2	1	0	79	0	0	0	2	0	4	1	0	2	2	0	0	2	0	1	4	10	11	11	
80	0	7	0	1	0	1	80	1	0	0	3	0	0	1	7	4	2	4	3	2	14	0	7	8	15	5	
81	2	4	1	2	0	4	81	0	0	0	4	0	9	0	6	2	2	7	1	17	0	1	5	15	9	1	
82	0	0	4	1	2	1	82	0	0	0	2	0	0	0	4	4	0	1	0	10	4	4	5	7	3	1	
83	0	1	2	0	0	0	83	1	0	0	3	2	0	3	0	0	0	2	0	1	3	2	6	19	5	2	
84	2	1	2	0	0	4	84	2	0	0	0	3	2	0	0	1	1	6	2	0	0	0	7	14	0	1	
85	3	0	0	0	0	5	85	1	0	0	0	0	0	0	4	6	0	4	3	1	3	0	8	8	0	0	
86	0	0	3	0	1	3	86	1	0	0	1	6	0	0	0	4	2	6	1	0	12	1	3	15	0	0	
87	0	1	4	0	2	2	87	2	0	0	2	0	8	3	0	0	5	3	4	2	8	4	9	11	10	0	
88	4	0	2	1	0	0	88	3	0	0	2	5	0	0	8	0	0	2	8	0	8	0	10	11	13	0	
89	2	6	1	1	7	0	89	3	0	0	0	3	4	0	3	2	4	2	22	1	17	3	12	19	5	0	
90	0	6	0	1	5	0	90	4	0	0	0	2	11	0	0	6	0	3	8	1	6	4	2	19	12	2	
91	0	5	1	0	6	1	91	0	0	0	0	1	4	1	0	4	6	3	7	3	11	0	8	18	15	1	
92	2	4	5	1	4	0	92	1	0	0	0	2	2	4	0	0	0	0	5	0	7	9	8	18	23	3	
93	0	4	8	0	0	0	93	0	0	0	0	0	4	4	0	2	0	1	8	0	7	7	9	16	21	4	
94	0	0	1	0	2	0	94	2	0	0	2	0	6	6	0	4	2	0	12	0	10	13	7	5	27	6	
95	0	1	3	1	1	0	95	0	0	0	0	1	0	0	0	3	4	1	5	1	6	13	7	1	8	6	
96	0	1	4	0	4	1	96	1	0	1	0	4	0	6	0	0	2	13	5	0	8	7	3	18	21	3	
97	0	1	2	0	5	1	97	0	0	9	0	1	0	2	1	0	4	1	1	0	1	9	5	15	26	3	
98	0	2	4	0	4	1	98	3	1	4	0	0	2	2	0	2	1	4	0	0	4	3	5	3	21	3	
99	0	2	4	0	4	2	99	0	1	1	0	0	1	3	0	0	4	12	0	1	5	6	2	7	33	4	

INDEX OF ALL BATTLES, 600 B.C. (-599) – A.D. 1957

*Zero Year is the Year 1 B.C.

Years Before Base Year (-)	Minus Base Years					
	-500	-400	-300	-200	-100	*0
0	8	8	9	7	6	0
1	3	8	2	7	5	1
2	0	2	1	0	12	0
3	0	5	0	1	4	0
4	0	9	2	1	5	1
5	2	12	2	5	3	0
6	0	4	3	6	1	2
7	4	6	0	3	11	1
8	5	9	0	8	6	9
9	7	8	3	5	10	2
10	12	13	5	3	9	5
11	1	2	7	3	3	3
12	3	6	0	2	5	2
13	2	11	2	10	0	1
14	5	12	3	1	3	0
15	2	8	4	8	3	6
16	0	5	8	8	0	3
17	3	2	5	12	2	0
18	0	4	4	5	4	0
19	8	0	1	5	1	2
20	2	1	3	3	6	0
21	5	4	2	9	8	0
22	5	2	6	4	3	5
23	0	7	0	2	5	1
24	2	8	0	4	1	4
25	3	5	4	4	9	1
26	4	5	3	6	3	0
27	3	3	1	0	0	0
28	2	5	5	1	2	1
29	2	2	5	4	7	2
30	3	4	8	0	2	9
31	0	4	6	5	3	6
32	0	4	4	2	4	2
33	1	1	5	0	7	0
34	1	2	4	2	7	3
35	1	0	6	0	7	7
36	1	0	2	4	0	0
37	2	0	4	5	2	5
38	3	1	1	5	2	4
39	4	3	4	2	2	0
40	5	4	4	9	2	0
41	0	0	2	5	2	6
42	1	0	7	0	1	4
43	1	0	9	3	1	3
44	0	3	4	2	3	4
45	3	1	2	3	6	7
46	5	1	1	2	8	6
47	0	4	5	5	4	5
48	2	5	7	0	2	5
49	6	7	5	4	1	8
50	4	5	5	7	4	7
51	0	0	3	0	2	12
52	2	0	3	0	2	12
53	2	1	3	2	7	7
54	2	6	3	3	5	4
55	4	2	6	3	0	2
56	3	6	4	3	0	6
57	0	4	5	0	0	4
58	0	5	2	0	2	2
59	2	4	3	2	2	5
60	1	8	1	5	2	1
61	6	4	4	3	1	2
62	0	2	2	5	1	8
63	0	3	2	2	4	5
64	0	2	1	2	4	1
65	0	8	3	2	7	2
66	0	1	0	0	0	1
67	2	4	3	1	5	5
68	1	4	4	0	1	3
69	0	6	7	2	2	1
70	0	3	7	3	9	1
71	2	3	3	3	2	0
72	0	4	3	0	0	9
73	0	4	0	3	1	2
74	0	1	1	4	0	0
75	0	6	7	0	3	3
76	0	1	3	5	3	3
77	0	5	3	5	3	4
78	0	7	5	4	4	8
79	0	12	5	4	3	2
80	0	7	0	4	2	5
81	4	5	1	4	0	4
82	2	0	7	5	7	13
83	1	3	4	0	1	5
84	4	3	2	1	4	5
85	4	2	1	2	6	5
86	0	4	3	2	2	8
87	0	4	6	2	2	8
88	4	1	2	5	4	5
89	4	10	2	1	8	3
90	4	7	3	4	5	7
91	0	7	3	2	6	2
92	3	11	5	1	4	0
93	3	7	8	1	0	0
94	2	3	3	2	2	0
95	4	7	5	6	1	3
96	2	4	5	1	5	1
97	2	3	3	0	5	3
98	2	5	5	4	6	1
99	1	7	5	0	4	6

Years After Base Year	Base Years A.D.																			
	*0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900
0	*	2	8	2	8	7	5	2	6	20	17	9	7	13	18	22	30	7	26	24
1	2	4	0	0	4	6	1	2	8	4	10	15	9	10	10	13	22	19	34	21
2	0	1	0	1	4	5	6	2	8	4	13	8	12	15	13	13	10	26	22	17
3	4	0	0	2	6	1	4	2	7	1	10	12	17	9	18	7	14	20	32	15
4	3	0	0	3	3	0	3	0	9	3	11	9	14	12	8	8	6	32	23	23
5	1	3	2	0	4	5	2	11	5	6	10	10	15	10	12	8	5	20	28	21
6	11	5	0	7	12	0	0	0	5	3	2	8	21	17	14	9	6	22	42	11
7	4	4	1	4	8	14	2	0	1	8	1	10	5	11	9	7	8	30	35	18
8	7	0	5	4	6	4	2	1	2	5	2	8	5	8	10	14	6	30	35	21
9	8	1	1	1	12	0	7	9	5	1	7	14	12	5	8	12	6	26	39	13
10	1	0	0	2	6	0	7	10	12	5	11	2	15	18	29	8	6	17	42	15
11	0	0	2	3	3	4	2	16	6	7	2	9	20	15	14	9	14	17	35	22
12	0	0	2	7	3	4	0	12	6	2	4	6	21	12	8	23	8	16	35	32
13	0	4	7	3	2	1	3	4	7	5	7	11	14	13	15	18	16	9	46	26
14	3	3	1	3	5	0	2	7	2	10	17	6	12	13	5	14	11	13	54	82
15	3	1	1	6	4	5	5	15	2	6	20	10	11	18	13	16	17	15	45	77
16	5	4	1	1	2	1	6	3	0	2	21	4	13	15	2	18	6	14	17	76
17	2	5	4	5	1	0	1	11	4	3	12	8	11	17	10	13	11	16	15	85
18	3	0	6	2	1	2	1	3	4	2	12	11	14	14	5	11	10	9	17	87
19	3	1	2	2	4	0	10	4	0	3	10	10	24	8	10	16	12	13	5	51
20	1	0	4	0	7	2	2	5	2	2	1	10	20	10	19	18	15	13	23	55
21	4	1	3	0	1	0	6	6	8	9	4	4	18	6	16	33	29	4	26	52
22	2	0	3	2	5	0	6	4	7	6	5	12	13	8	19	19	20	8	20	43
23	3	0	0	6	2	2	8	1	9	12	3	13	14	14	7	16	24	14	18	17
24	2	0	2	3	0	0	4	4	5	7	5	11	16	10	9	20	17	7	13	28
25	2	0	2	0	3	4	3	5	2	2	2	14	14	13	7	18	16	1	13	20
26	2	1	5	0	1	4	12	4	4	12	10	18	10	13	10	26	23	0	23	23
27	0	0	1	0	0	3	12	5	6	11	4	16	25	18	14	22	19	5	25	25
28	1	0	1	0	5	6	7	7	2	15	14	11	17	12	13	17	13	0	35	20
29	0	1	1	0	9	5	10	12	2	15	6	7	8	8	12	17	8	2	22	26
30	0	0	1	1	6	4	8	5	5	20	17	9	11	15	15	6	19	6	31	36
31	0	3	2	0	0	17	2	4	8	11	15	1	12	8	16	16	22	4	30	28
32	0	3	2	1	3	14	7	12	11	11	8	6	9	7	7	12	18	4	30	22
33	1	2	1	0	4	7	8	1	14	17	9	2	12	9	6	10	7	6	14	13
34	0	2	1	0	0	14	9	0	5	18	9	1	16	5	10	11	18	16	14	16
35	0	6	3	1	4	10	7	0	10	11	13	6	10	12	12	15	17	4	7	23
36	2	2	1	1	0	6	9	0	5	5	6	14	11	22	8	12	11	17	7	20
37	0	2	2	4	5	2	8	2	8	11	9	6	13	23	6	19	22	12	19	30
38	2	0	5	6	0	0	9	2	10	2	19	12	20	13	11	14	22	10	16	44
39	1	0	0	1	3	8	7	2	4	11	13	17	17	13	11	12	18	21	30	51
40	2	1	2	4	0	4	11	9	16	12	13	11	29	23	12	16	15	12	22	39
41	2	2	1	0	3	9	14	11	14	14	6	9	27	11	10	11	11	15	20	153
42	2	6	1	1	7	0	12	6	9	6	12	10	5	6	8	20	19	13	18	152
43	3	0	0	0	2	3	6	9	4	7	12	7	5	9	11	8	17	11	21	152
44	3	0	3	0	0	0	7	2	6	11	5	7	11	5	10	8	19	14	17	152
45	2	1	0	4	2	4	8	9	5	8	4	9	14	9	7	9	18	25	12	152
46	4	0	0	4	6	10	4	4	8	10	4	11	8	12	9	17	14	18	17	52
47	0	2	0	0	4	1	8	3	9	15	8	26	13	22	11	14	10	27	22	35
48	1	2	4	4	10	0	6	2	5	9	3	7	11	16	13	11	34	11	54	26
49	1	0	4	0	10	15	4	5	5	5	5	10	4	11	14	11	10	7	47	33
50	2	3	2	7	3	12	3	8	8	7	8	13	12	15	10	3	22	10	16	45
51	0	0	4	3	20	1	5	6	5	8	7	5	5	8	16	11	23	10	17	25
52	0	1	0	2	7	14	2	5	11	6	8	8	10	9	13	18	19	8	14	16
53	0	0	7	5	8	9	2	5	5	2	5	13	9	15	14	7	20	6	26	27
54	0	0	2	1	6	10	1	16	3	6	11	7	18	15	11	5	16	6	25	25
55	1	2	5	2	7	13	2	9	11	8	8	10	9	10	13	4	19	18	22	28
56	0	1	0	0	8	2	3	16	3	4	2	9	8	12	18	13	29	26	20	66
57	0	2	3	9	5	4	2	1	3	5	5	13	12	10	8	18	17	22	25	74
58	3	0	7	9	1	5	4	14	5	6	2	14	17	17	13	17	24	25	23	
59	4	0	4	6	7	3	6	9	1	4	4	11	3	13	9	8	13	22	37	
60	0	3	4	4	0	1	1	6	13	8	4	16	11	16	5	12	13	25	30	
61	3	2	1	3	1	0	4	9	8	13	7	8	11	15	25	13	12	20	33	
62	1	2	0	5	1	5	2	5	12	15	7	10	8	14	24	8	29	17	24	
63	0	0	4	9	1	1	5	8	6	9	5	8	10	13	13	15	17	15	41	
64	2	0	1	4	2	0	0	5	6	11	11	13	12	2	12	14	20	14	39	
65	2	8	3	2	0	0	2	5	4	5	8	5	9	9	13	28	15	5	26	
66	4	4	1	8	2	8	0	5	11	24	15	4	12	18	20	25	21	10	37	
67	3	0	5	9	2	2	0	5	11	4	3	7	7	7	18	25	23	9	28	
68	9	3	5	4	7	19	14	6	3	20	10	4	16	15	19	22	6	13	35	
69	10	1	5	1	2	8	0	3	0	13	9	5	14	14	12	19	18	12	17	
70	6	2	9	2	2	4	5	3	7	7	10	3	8	12	18	22	12	18	22	
71	4	1	12	0	4	1	7	5	20	10	19	6	9	12	19	19	15	16	13	
72	1	2	7	2	4	15	5	4	11	3	8	2	11	2	10	17	32	12	7	
73	4	1	8	1	3	7	2	5	4	17	18	7	19	6	8	16	23	11	14	
74	0	3	3	2	0	2	1	11	2	12	8	13	16	5	16	25	27	19	12	
75	0	2	3	10	1	10	2	3	6	14	8	12	12	15	15	15	26	18	10	
76	2	0	2	3	9	9	0	15	3	14	17	15	8	16	20	22	24	17	18	
77	1	3	3	2	5	8	5	7	11	9	11	11	19	15	18	14	24	8	17	
78	6	3	1	8	0	6	3	12	19	5	5	10	13	12	17	20	14	20	21	
79	0	6	2	3	3	5	10	2	7	8	1	5	9	15	8	22	13	26	19	
80	3	2	2	5	0	3	7	11	7	16	8	17	11	26	8	23	14	29	13	
81	1	0	0	4	3	14	9	6	5	18	14	15	27	14	16	12	18	25	20	
82	0	1	0	2	0	1	4	8	10	12	6	8	23	15	18	14	9	11	14	
83	1	4	2	4	2	1	10	1	3	12	3	10	12	14	11	17	33	10	17	
84	2	3	1	1	3	3	3	2	10	3	10	11	11	2	9	14	20	13	10	
85	2	1	2	0	0	2	6	10	12	12	8	15	9	13	15	16	17	11	18	
86	1	2	7	1	7	3	4	3	8	11	14	12	7	18	7	14	20	11	14	
87	2	0	3	4	0	11	8	4	9	19	3	11	7	14	11	21	16	25	7	
88	4	0	4	5	5	0	1	10	4	6	8	11	9	20	12	19	23	29	4	
89	5	4	1	4	3	5	1	8	6	10	3	27	10	25	11	18	28	24	15	
90	4	0	0	1	3	13	2	7	10	4	5	15	15	10	10	12	22	33	13	
91	0	2	1	2	1	5	3	3	9	12	7	14	13	19	5	18	23	26	9	
92	1	3	2	1	2	4	9	11	3	2	4	12	6	17	17	24	20	36	11	
93	0	3	1	0	7	4	7	3	5	2	10	17	10	19	9	20	18	29	25	
94	2	4	2	7	0	6	9	2	10	6	4	19	11	20	16	15	7	44	28	
95	3	0	3	3	1	0	3	4	12	17	9	12	10	11	16	19	5	23	19	
96	3	5	6	0	4	0	8	6	11	5	18	10	16	20	8	9	25	28	24	
97	2	4	9	3	4	0	11	6	2	15	9	16	12	4	12	15	15	35	22	
98	4	4	4	5	0	2	4	4	5	6	6	7	13	11	4	14	6	34	26	
99	1	2	1	0	0	3	4	10	3	12	22	7	15	20	11	19	12	36	23	

THE

FOUNDATION FOR THE STUDY OF CYCLES'

DIRECTORY

OF

CYCLE SCIENTISTS

THE FOUNDATION FOR THE STUDY OF CYCLES
680 WEST END AVENUE
NEW YORK 25, NEW YORK

FOREWORD

Cycle study transcends the boundaries of the individual disciplines. This is so because the techniques are the same whether one is studying cycles in the abundance of grasshoppers or in the number of international battles. It is so because a cycle wave length discovered by a dendrochronologist may be the same as a cycle wave length discovered by an economist, thus suggesting at least the possibility of a common cause.

However, with today's specialization, how is a worker in one field to know even the names of the workers in other fields, unless there is a place to which he can turn for reference?

This thought stimulated the Foundation for the Study of Cycles in 1940 to issue its first Directory of Cycle Students. We present herewith a revision, bringing the original work up to date.

The editors will appreciate learning of errors of commission and of omission.

DIRECTORY

A

ABBOT, CHARLES GREELEY, Smithsonian Institution, Washington, D. C. Research Associate. Astrophysics, Climatology.

ABBOTT, W. N., 313 Manukau Road, Epson Auckland, New Zealand. Physician and Clinical Biophysicist. Agronomy, Geophysics, Ichthyology, Limnology, Mammalogy, Medicine, Meteorology, Climatology, Oceanography, Volcanology.

ADAMS, WALTER SYDNEY, 873 N. Hill Avenue, Pasadena 7, California. Astronomy, Astrophysics.

ADLER, HELMUT E., American Museum of Natural History, Central Park West & 79th Street, New York, New York. Zoology.

AITKEN, ALEXANDER C., University of Edinburg, 74 Trinity Road, Edinburg 5, Scotland. Mathematics, Statistics.

ALTER, DINSMORE, 1829 Berryman Street, Berkeley 3, California. Astronomy, Astrophysics.

ALVARES, ANTONIO M., Box 8247, Puerto Rico. Astronomy, Geophysics, Medicine, Meteorology, Climatology, Seismology.

ANDERSON, CLIFFORD NORMAN, 133 Summit Avenue, Summit, New Jersey. Formerly with Bell Telephone Laboratory. Astronomy, Astrophysics.

ANDERSON, J. A., University of Minnesota Medical School, Minneapolis, Minnesota. Professor of Pediatrics.

ANDERSON, RICHARD L., North Carolina State College, Raleigh, North Carolina. Professor of Statistics. Mathematics, Statistics.

ANDREWS, EDSON J., 205 E. College Avenue, Tallahassee, Florida.

ANTEVS, ERNST VOLDEMAR, The Corral, Globe, Arizona.

ANTHONY, HAROLD ELMER, American Museum of Natural History, New York, New York. Chairman and Curator, Department of Mammals. Mammalogy.

ARMSTRONG, CHARLES E., American Telephone and Telegraph Company, 195 Broadway, New York, New York. Mathematics, Statistics, Economics.

ASCHOFF, JURGEN, Institut für Physiologie, Max-Planck-Institit für Medizinische Forschung Jahnstrasse 29, Heidelberg, Germany. Physiology.

ASDELL, SYDNEY ARTHUR, Cornell University, Ithaca, New York. Professor of Animal Physiology. Mammalogy, Zoology, Physiology.

B

BALLS, WILLIAM LAWRENCE, Egyptian Ministry of Agriculture, Cairo, Egypt. Cotton Technologist. Agronomy.

BARNWELL, FRANKLIN H., Northwestern University, Evanston, Illinois. Biology.

BARTELS, JULIUS, University of Göttingen, Herzberger Landstrasse 180 (20B) Göttingen, Germany. Professor of Geophysics and Director of the Institute für Stratosphären-Physik im Max-Planck-Institute für Aeronomie. Geomagnetism, Geophysics, Mathematics, Statistics, Meteorology, Climatology.

BARTTER, FREDERIC C., Clinical Endocrinology Branch, National Heart Institute, National

Institutes of Health, Bethesda 14, Maryland. Medical Director. Endocrinology and Renal Functions.

BATES, STEWART, Central Mortgage and Housing, Montreal Road, Ottawa, Canada. President. Economics.

BATTLE, HELEN IRENE, University of Western Ontario, London, Ontario, Canada. Professor of Zoology, Ichthyology, Zoology.

BEAN, LOUIS H., 3714 N. Randolph Street, Arlington, Virginia. Formerly Economic Advisor, Office of the Secretary of Agriculture, U. S. Department of Agriculture. Agronomy, Economics, Meteorology, Climatology.

BECHTOLD, IRA C., 1987 Skyline Vista Drive, La Habra, California. Consultant. Geophysics.

BELDING, DAVID LAWRENCE, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Associate Scientist. Ichthyology, Limnology.

BELL, J. FREDERICK, Rocky Mountain Laboratory, U. S. Public Health Service, Hamilton, Montana. Medical Director. Mammalogy.

BENNETT, KENNETH ROBERT, Pennsylvania State University, University Park, Pennsylvania. Professor of Agricultural Economics and Experiment Station Statistician. Economics.

BENNETT, MIRIAM F., Department of Biology, Sweet Briar College, Sweet Briar, Virginia. Zoology.

BETHE, HANS ALBRECHT, Laboratory of Nuclear Studies, Cornell University, Ithaca, New York. Astronomy, Astrophysics.

BEVERIDGE, WILLIAM, Oxford, England. Economics.

BIRD, RALPH DURHAM, Canada Agriculture Research Laboratory, University of Manitoba, Winnipeg 9, Manitoba, Canada. Head, Entomology Section. Entomology.

BLACKBURN, RAYMOND F., School of Business Administration, University of Pittsburgh, Pittsburgh, Pennsylvania. Professor and Head, Department of Statistics. Statistics.

BLAIR, W. FRANK, University of Texas, Austin, Texas. Professor of Zoology. Herpetology, Mammalogy.

BLISS, DOROTHY E., The American Museum of Natural History, New York, New York. Zoology.

BOLLINGER, CLYDE JOHN, University of Oklahoma, Norman, Oklahoma, Associate Professor of Geography Emeritus. Astronomy, Astrophysics, Geophysics, Hydrology, Meteorology,

BOOLOOTIAN, RICHARD A., Department of Zoology, University of California, Los Angeles, California. Zoology.

BOWERMAN, WALTER G., 745 Schaefer Avenue, Oradell, New Jersey. Formerly Assistant Actuary, New York Life Insurance Company. Astronomy, Astrophysics, Biology, Medicine.

BRADLEY, WILMOT HYDE, U. S. Geological Survey, Washington, D. C. Chief Geologist. Geology.

BRANDT, E., University of Oklahoma Medical School, Oklahoma City, Oklahoma. Medical Statistics.

BRAY, J. R., Department of Botany, University of Toronto, Toronto, Ontario, Canada. Assistant Professor. Botany.

BREHME-WARREN, KATHERINE, Adelphi College, Garden City, L. I., New York, Associate Professor.

BRETT, WILLIAM J., Science Department, Indiana State College, Terra Haute, Indiana. Biology.

BRICK, I. B., Medical Center, Georgetown University, Washington, D. C. Assistant Professor.

BRIER, GLENN W., United States Weather Bureau, Washington, D. C. Chief Meteorologist Statistical Section. Climatology.

BROWMAN, LUDVIG G., Department of Zoology, Montana State University, Missoula, Montana. Mammalogy, Zoology.

BROWN, FRANK A., JR., Northwestern University, Evanston, Illinois. Morrison Professor of Biology. Biology, Botany, Entomology, Herpetology, Psychology, Zoology.

BRUCE, VICTOR G., Department of Biology, Princeton University, Princeton, New Jersey. Biology.

BRUNT, DAVID, Electricity Supply Research Council, Trafalgar Buildings, Charing Cross, London, S. W. 1, England. Climatology.

BUCK, JOHN B., National Institute of Health, Bethesda 14, Maryland. Entomology.

BURGER, J. WENDELL, Trinity College, Hartford, Connecticut. Professor of Biology. Herpetology Ichthyology, Limnology, Ornithology.

BURKENROAD, MARTIN D., Apartado 6231, Panama, Republic of Panama. Ichthyology.

BURNS, ARTHUR FRANK, Columbia University, New York, New York. Professor of Economics. Economics.

BURR, HAROLD SAXTON, Yale School of Medicine, New Haven, Connecticut. E. K. Hunt Professor Emeritus, Botany, Biology, Medicine.

BURT, WILLIAM HENRY, Museum of Zoology, University of Michigan, Ann Arbor, Michigan. Mammalogy.

BUTLER, LEONARD, University of Toronto, Toronto, Ontario, Canada. Professor of Genetics. Biology, Mammalogy.

C

CAIN, STANLEY ADAIR, Department of Conservation, University of Michigan, Ann Arbor, Michigan. Professor and Chairman. Biology.

CAMERON, THOMAS WRIGHT MOIR, McGill University, Montreal, Quebec, Canada. Bacteriology.

CARD, DANA GEORGE, University of Kentucky, Lexington, Kentucky. Professor of Agricultural Economics. Economics, Meteorology, Climatology.

CASTLE, DUDLEY S., Route 5, Box 40-W, Excelsior, Minnesota. Economics.

CHANEY, RALPH, University of California, Berkeley, California. Professor Emeritus. Geology.

CHAPIN, FRANCIS STUART, University of Minnesota, Minneapolis, Minnesota, Emeritus Professor of Sociology. Sociology.

CHAPMAN, C. R., Purdue University, Lafayette, Indiana. Assistant Professor of Electrical Engineering. Economics.

CHAPMAN, SYDNEY, Geophysical Institute, College, Alaska. Mathematics, Statistics.

CHAPPLE, CHARLES CULLODEN, 2013 Church Road, Flourtown, Pennsylvania. Medicine.

CHITTY, DENNIS H., Department of Zoology, University of British Columbia, Vancouver, British Columbia, Canada. Mammalogy.

CLARKE, CHARLES HENRY DOUGLAS, Department of Lands and Forests, Toronto, Ontario, Canada. Assistant Chief, Fish and Wildlife Branch. Ornithology.

CLYNES, M. E., Rockland State Hospital, Orangenburg, New York.

COGAN, L. PETER, Peter L. Cogan Foundation, Incorporated, New York, New York. President. Medicine.

COLE, LAMONT COOK, Cornell University, Ithaca, New York. Professor of Zoology. Mammalogy, Biology, Entomology, Mathematics, Statistics.

CONRAD, VICTOR, 195 Upland Road, Cambridge, Massachusetts. Formerly Research Associate in Climatology, Harvard University. Meteorology, Climatology, Seismology.

COURTRIGHT, L. J., 490 Post Street, San Francisco, California. Medicine.

COWAN, IAN MCTAGGART, University of British Columbia, Vancouver, British Columbia, Canada. Head, Department of Zoology. Mammalogy.

COWGILL, DONALD OLEN, University of Wichita, Wichita, Kansas. Professor of Sociology. Sociology.

COWLES, ALFRED, Cowles Commission for Research in Economics, University of Chicago, Chicago, Illinois, President, Economics.

COWLES, RAYMOND BRIDGMAN, University of California. Los Angeles, California. Biology.

CROXTON, FREDERICK EMORY, Columbia University New York, New York. Professor of Statistics. Economics.

D

DAMANN, KENNETH EUGENE, Eastern Illinois State College, Charleston, Illinois. Professor of Botany. Bacteriology, Biology, Ichthyology, Limnology.

DANSON, JOHN FRANCIS, Wotton Lodge, Ingatestone, Essex, England. Economics, Mathematics, Statistics.

DAVIES, GEORGE REGINALD, Bureau of Business and Economic Research, State University of Iowa, Iowa City, Iowa. Statistician. Economics, History, Sociology.

DAVIS, HAROLD T., Northwestern University, Evanston, Illinois. Professor of Statistics. Economics.

DeCOURSEY, PATRICIA, Department of Zoology, University of Wisconsin, Madison, Wisconsin. Zoology.

DEEVEY, EDWARD S., Osborn Zoological Laboratory, Yale University, New Haven, Connecticut. Associate Professor and Director. Zoology.

deGRYSE, JOSEPH J., Division of Entomology, Central Experiment Farm, Ottawa, Canada. Entomology.

De LURY, RALPH EMERSON, Solar Physics Division Dominion Observatory, Ottawa, Ontario, Canada. Formerly Acting Director. Astronomy, Astrophysics.

De SMITT, VALADIMIR P., Columbia University, New York, New York. Research Associate in Geology. Astronomy, Astrophysics, Geology, Geomagnetism, Geophysics, Meteorology, Climatology, Oceanography.

De TERRA, HELMUT, Columbia University, New York, New York. Research Associate. Climatology.

DEWEY, EDWARD R., Foundation for the Study of Cycles, 680 West End Avenue, New York 25, New York. Executive Director. Cycle study as such.

DEXTER, RALPH W., Department of Biology, Kent State University, Kent, Ohio. Zoology.

DICE, LEE R., University of Michigan, Ann Arbor, Michigan. Professor Emeritus of Zoology. Ecology, Mammalogy.

DILLER, OLIVER DANIEL, Department of Forestry, Ohio Agricultural Experiment Station, Wooster, Ohio. Chairman. Forestry.

DORLAND, JACK A., 10 Castle Heights, Tarrytown, New York. Economics, Geomagnetism, Psychology.

DOUGLASS, ANDREW ELLICOTT, Tree Ring Laboratory, University of Arizona, Tucson, Arizona. Dendrochronology.

DOWNING, STUART CHALMERS, Royal Ontario Museum of Zoology, Toronto, Canada. Mammalogy.

DREYER, WILLIAM A., University of Cincinnati, Cincinnati, Ohio. Professor, Zoology. Entomology.

DUNBAR, MAXWELL JOHN, McGill University, Montreal, Quebec, Canada. Professor of Zoology. Biology, Oceanography, Zoology.

DUNBAR, VERYL L., The American Telephone and Telegraph Company, Cincinnati, Ohio. Economics.

DUSTAN, G. G., Entomology Laboratory, Vineland Station, Ontario, Canada. Officer in Charge. Entomology.

DYMOND, JOHN RICHARDSON, University of Toronto Toronto, Ontario, Canada. Emeritus Professor of Zoology. Ichthyology, Mammalogy, Zoology.

E

ELTON, CHARLES, Bureau of Animal Population, Oxford, England. Director. Mammalogy.

EHRET, CHARLES F., Argonne National Laboratory, Division of Biological & Medical Research, Lamont, Illinois. Microorganisms.

EMERSON, ALFRED E., University of Chicago, Chicago, Illinois. Professor of Zoology. Biology, Entomology, Zoology, Animal Ecology.

EMILIANI, CESARE, Marine Laboratory, University of Miami, Miami, Florida. Climatology.

ENGEL, R., Department of Neurology, University of Oregon, Portland, Oregon.

ERHARDT, CARL L., Department of Health, New York City 13, New York. Director of the Bureau of Records and Statistics. Medicine.

ERICKSON, ARNOLD B., Minnesota Division of Game and Fish, St. Paul, Minnesota. Game Research Supervisor. Mammalogy.

ERRINGTON, PAUL LESTER, Iowa State College, Ames, Iowa. Professor of Zoology. Mammalogy, Biology, Ornithology, Zoology, Ecology, Epidemiology, Physiology.

F

FAIRBRIDGE, RHODES W., Columbia University, New York, New York. Professor of Geology. Geology, Climatology.

FALLIS, ALBERT MURRAY, Ontario Research Foundation, Toronto, Ontario, Canada. Director of Parasitology. Ornithology.

FERRIE, R. M., Saskatchewan Fish and Game League, Saskatoon, Saskatchewan, Canada. Ornithology, Mammalogy, Ichthyology, Limnology.

FINGERMAN, MILTON, Tulane University, New Orleans, Louisiana. Zoology.

FOERSTER, R. E., Biological Station, Fisheries Research Board of Canada, Nanaimo, British, Columbis, Canada. Principal Scientist. Ichthyology, Limnology.

FOLK, G. EDGAR, Department of Physiology, State University of Iowa, Iowa City, Iowa. Zoology.

FORBES, WILLIAM T. M., Commander Hotel, Cambridge, Massachusetts. Entomology.

FORBUSH, SCOTT E., Carnegie Institution of Washington. Washington, D. C. Geophysics.

FRITTS, HAROLD C., University of Arizona, Tucson, Arizona. Assistant Professor of Dendrochronology. Botany.

FRITZ, EMANUEL, University of California, Berkeley, California. Emeritus Professor of Forestry, Consultant in Forestry and Lumbering. Botany, Forestry.

FRYER, DOUGLAS, New York University, New York, New York. Associate Professor of Psychology. Psychology.

G

GALICICH, J. H., Box 326, University of Minnesota Hospital, Minneapolis, Minnesota.

GAPOSCHKIN, CECILIA PAYNE, Harvard University, Cambridge, Massachusetts. Astronomy, Astrophysics.

GARCIA-MATA, CARLOS, Oenoke Ridge, New Canaan, Connecticut. Economics.

GAUBIS, ANTHONY, 122 E. 42nd Street, New York, New York. Economics.

GAUMNITZ, ERWIN A., School of Commerce, University of Wisconsin, Madison, Wisconsin. Dean. Statistics, Economics.

GERMANN, PAUL J., College of St. Thomas, St. Paul, Minnesota. Associate Professor of Botany. Botany.

GIBBS, FREDERIC A., Department of Neurology, Harvard Medical School, Boston, Massachusetts. Physiology.

GIFFORD, S., Peter Bent Brigham Hospital, 721 Huntington Avenue, Boston, Massachusetts.

GLOCK, WALDO S., Department of Geology, Macalaster College, St. Paul, Minnesota. Chairman. Botany, Forestry, Dendrochronology.

GORHAM, RAYMOND PAUL, Division of Applied Biology, National Research Council of Canada, Ottawa, Ontario, Canada. Associate Research Officer. Entomology.

GOULD, EDWIN, Department of Zoology, Tulane University, New Orleans, Louisiana. Herpetology.

GRAHAM, KENNETH, University of British Columbia, Vancouver, B. C., Canada. Entomology.

GRANGE, WALLACE BYRAN, Sandhill Game Farm, Babcock, Wisconsin. President. Biology.

GRAY, STEPHEN W., Emory University, Atlanta, Georgia. Associate Professor of Anatomy. History, Medicine.

GREBE, JOHN JOSEPH, Dow Chemical Company, Midland, Michigan. Director, Nuclear Research and Development, Astronomy, Astrophysics, Psychology, Sociology.

GRIFFIN, DONALD R., Biological Laboratories, Harvard University, Cambridge, Massachusetts. Zoology.

GROSS, ALFRED OTTO, Bowdoin College, Brunswick Maine. Professor Emeritus of Biology and Ornithology. Ornithology.

GUMBEL, EMIL J., Columbia University, New York, New York. Hydrology, Mathematics, Statistics.

GUNTER, GORDON, Gulf Coast Research Laboratory, Ocean Springs, Mississippi. Ichthyology. Limnology, Zoology.

GUYSELMAN, J. BRUCE, Department of Biology, Carleton College, Northfield, Minnesota. Zoology.

H

HALBERG, FRANZ, Department of Pathology, University of Minnesota, Minneapolis, Minnesota. Medicine.

HALL, EUGENE RAYMOND, Department of Zoology, University of Kansas, Lawrence, Kansas. Chairman. Mammalogy.

HAMILTON, WILLIAM JOHN, JR., Department of Conservation, Cornell University, Ithaca, New York. Professor of Zoology. Mammalogy, Zoology.

HAMNER, KARL C., Department of Botany, University of California, Los Angeles, California. Botany.

HANSEN, HENRY P., Oregon State College, Corvallis, Oregon. Professor of Palynology. Biology, Botany, Dendrochronology, Geology.

HARPER, F. A., Foundation for Voluntary Welfare, Burlingame, California. Research Director. Economics.

HARVEY, JOHN, Consumers Power Company, Jackson, Michigan. Plant Accounting Engineer. Economics.

HASLER, ARTHUR D., Department of Zoology, University of Wisconsin, Madison, Wisconsin. Zoology.

HAUGEN, ARNOLD OTTO, Iowa State University, Ames, Iowa. Professor of Zoology, Leader Wildlife Research Unit. Mammalogy.

HAUS, E., 264 Lyones Laboratory, Department of Pathology, Division of Cancer Biology, University of Minnesota, Minneapolis, Minnesota. Biology.

HAUTY, G. T., Civil Aeromedical Research Institute, Oklahoma City, Oklahoma. Chief, Psychology Branch. Psychophysiology.

HAVILL, B. G., Haskins and Sells, Dallas, Texas. Public Accountant. Mathematics, Statistics.

HAWKING, FRANK, National Institute for Medical Research, Mill Hill, London, England. Head of Division of Chemotherapy and Parasitology. Periodicity of Microfilariae.

HAYDU, G. G., Creedmoor Institute for Psychobiologic Studies, New York, New York. Periodicity of the Self-Structure, Periodicity in Cultural Evolution.

HECKERT, HILMAR, Fraziusweg 78, Berlin-Lichtenrade, Germany. Bacteriology, Medicine, Biology.

HENDRICKS. STERLING B., Mineral Nutrition Laboratory, U. S. Department of Agriculture, Soil and Water Conservation Research Division, Beltsville, Maryland. Botany.

HERSEY, REXFORD B., University of Pennsylvania, Philadelphia, Pennsylvania. Professor of Industry (Mental Hygiene). Sociology.

HEUSSER, C. J., American Geographical Society, Broadway at 156th Street, New York, New York. Research Associate.

HICKS, LAWRENCE EMERSON, Buckeye Apiaries and Buckeye Honey Company, Columbus, Ohio. Research Director. Biology.

HIGHKIN, HARRY R., Division of Biology, California Institute of Technology, Pasadena, California. Botany.

HIMMELBLAU, DAVID M., University of Texas, Austin, Texas. Assistant Professor, Department of Chemical Engineering. Economics.

HOAGLAND, HUDSON, Worcester Foundation for Experimental Biology, Shrewsbury, Massachusetts. Executive Director. Psychology, Physiology.

HOBAEK, ANDREAS, Norges, Tannlegehogskole, Oslo, Norway. Limnology.

HODSON, A. C., University of Minnesota, Minneapolis, Minnesota. Professor. Entomology.

HOFFMAN, ROBERT S., Montana State University, Missoula, Montana. Professor of Zoology. Zoology.

HOOVER, J. EDGAR, Federal Bureau of Investigation, Washington, D. C. Director. Sociology.

HOSKINS, CHAPIN, Institute of Trend Research, Hopkinton, New Hampshire. Chairman of Trustees. Astronomy, Astrophysics, Economics, History, Medicine, Meteorology, Climatology, Psychology.

HOTELLING, HAROLD, University of North Carolina, Chapel Hill, North Carolina. Professor of Statistics. Mathematics, Statistics.

HUGHEY, VEDDER, P. O. Box 1245, Coral Gables, Florida. Economics, Mathematics, Statistics.

HUNT, H., University of Nebraska, College of Medicine, Omaha, Nebraska. Professor.

HUNTSMAN, ARCHIBALD GOWANLOCH, University of Toronto, Toronto, Ontario, Canada. Formerly Professor of Marine Biology. Ichthyology, Limnology, Oceanography.

HURWICZ, LEONID, University of Minnesota, Minneapolis, Minnesota. Professor of Economics and Mathematics. Economics, Mathematics, Statistics.

HUTCHINSON, GEORGE EVELYN, Yale University, New Haven, Connecticut. Professor of Biology. Biology.

HUTNER, SIMEON, Room 2114, One Wall Street New York, New York. Economics.

HUXLEY, JULIAN, Zoological Society of London, Regents Park, London, N.W.S., England. Secretary. Zoology.

HYDE, H. A., National Museum of Wales, Cardiff, Wales. Keeper of Botany. Biology, Botany, Medicine.

I

ISCHOLONDSKY, N. DORIN, 301 Park Avenue, New York, New York. Medicine.

J

JAMES, FRANK CYRIL, McGill University, Montreal, Quebec, Canada. Principal and Vice Chancellor. Economics.

JARDETZKY, CHRISTINE, Biological Laboratories, Harvard University, Cambridge, Massachusetts.

JARDETZKY, OLEG, Harvard Medical School, Boston, Massachusetts.

JARVIS, CLARENCE SYLVESTER, Watsonville, California. Civil and Hydraulic Engineer, Retired. Hydrology, Meteorology, Climatology.

JEFFREYS, HAROLD, St. John's College, Cambridge University, Cambridge, England. Geophysics.

JENNER, CHARLES E., Department of Zoology, University of North Carolina, Chapel Hill, North Carolina. Zoology.

JENSEN, EINAR, Rjukan Salpeterfabriker, Rjukan, Norway. Director of Laboratory. Limnology.

JOHNSON, LEROY PETER VERNON, University of Alberta, Edmonton, Alberta, Canada. Professor of Genetics and Plant Breeding. Agronomy, Meteorology, Climatology.

JOHNSON, ROGER, Associated Industries of Massachusetts, Boston, Massachusetts. Economist. Economics.

JOHNSTON, HENRY FREEBORN, National Bureau of Standards, Washington, D. C. Geophysicist. Astronomy, Astrophysics, Geophysics, Mathematics, Statistics, Geomagnetism, Meteorology, Climatology, Oceanography.

JOQUEL, ARTHUR LOUIS, II, Challenger Research Institute, Phoenix, Arizona. Director. History.

JORES, ARTHUR, II. Med. Universitatsklinik, Hamburg-Eppendorf, Germany. Medicine.

JOY, ALFRED HARRISON, Mt. Wilson Observatory, Pasadena, California. Astronomer and Secretary. Astronomy, Astrophysics.

K

KAC, MARK, Cornell University, Ithaca, New York. Professor of Mathematics. Statistics.

KALELA, OLAUI, University of Helsinki, Finland. Professor of Zoology. Zoology.

KALMUS, H., University College of London, London, England. Reader in Biology.

KAUFMAN, SHERWIN A., 59 E. 54th Street, New York, New York. Medical Director of Planned Parenthood of Manhattan and the Bronx.

KELLOGG, ARTHUR REMINGTON, Smithsonian Institution, Washington, D. C. Mammalogy.

KENDEIGH, S. C., Department of Zoology, University of Illinois, Urbana, Illinois. Ornithology.

KING, HUGH P., Continental Copper & Steel Industries, Inc., 120 Broadway, New York, New York, Economist, Economics.

KING, WILLFORD ISBELL, New York University, New York, New York. Professor Emeritus Economics. Economics, Statistics.

KITCHIN, JOSEPH ARMSTRONG, United States Information Service, Calculla, India. American Consultant and Public Affairs Officer. Economics.

KLEINHOLZ, L. H., Reed College, Portland, Oregon. Professor of Biology. Zoology.

KLEINHOONTE, ANTHONIA, University College of Technology, Niewe, Plantage 13, Delft, Netherlands.

KLEITMAN, NATHANIEL, University of Chicago, Chicago, Illinois. Formerly Professor of Physiology. Physiology, Biology.

KONTKANXEN, P., University of Helsinki, Finland. Professor of Zoology.

KOSKIMIES, JUKKA, Department of Zoology, University of Helsinki, p. Rautatiekatu 13, Helsinki, Finland. Zoology.

KRIS, E. CHRISTINE, 863 Massachusetts Avenue, Cambridge, Massachusetts. Zoology.

KROTKOV, GLEB, Queen's University, Kingston, Ontario, Canada. Professor of Biology. Botany.

KUZNETS, SIMON, University of Pennsylvania, Philadelphia, Pennsylvania. Mathematics, Statistics.

L

LACEY, J. I., Fels Research Institute, Antioch College, Yellow Springs, Ohio. Professor. Psychology.

LACKEY, JAMES B., University of Florida, Gainesville, Florida. Professor of Sanitary Sciences. Biology, Limnology, Zoology.

LAIRD, DONALD ANDERSON, Route 2, Lafayette, Indiana. Psychology.

LANDIS, C., New York State Psychiatric Institute, Columbia University, New York, New York.

LARKS, S. D., Department of Biophysics, University of California, Medical Center, Los Angeles, California.

LAWRENCE, DONALD BUERMANN, University of Minnesota, Minneapolis, Minnesota. Professor of Botany. Botany, Dendrochronology, Meteorology, Climatology.

LEHRMAN, DANIEL S., Rutgers University, New Brunswick, New Jersey. Assistant Professor of Psychology.

LEINWEBER, FRANZ J., McCollum-Pratt Institute, Johns Hopkins University, Baltimore, Maryland. Botany.

LEONTIEF, WASSILY W., Harvard University, Cambridge, Massachusetts. Professor of Economics. Economics.

LESSE, S., 15 West 81st Street, New York, New York.

LINSDALE, JEAN MYRON, University of California, Haskings Reservation, Carmel Valley, California. Mammalogy.

LIVINGSTON, WILLIAM T., Alexander Hamilton Institute, New York, New York. Editor. Economics.

LLOYD, HOYES, Rockcliffe Park, Ottawa, Ontario, Canada. Formerly Superintendent of Wildlife Protection. Mammology. Ornithology.

LOBEL, H., The Creighton University, School of Pharmacy, Omaha, Nebraska.

LOCKHEAD, ALLEN GRANT, Canadian Department of Agriculture, Ottawa, Ontario, Canada. Bacteriologist. Bacteriology.

LONG, CLARENCE DICKINSON, National Bureau of Economic Research, Bouce Avenue, Ruxton, Maryland. Economics.

LYON, CHARLES JULIUS, Dartmouth College, Hanover, New Hampshire. Professor of Botany. Dendrochronology.

M

MACAULAY, FREDERICK ROBERTSON, National Bureau of Economic Research, New York, New York. Economist (Retired). Mathematics, Statistics, Economics.

MacLULISH, DUNCAN ALEXANDER, Ottawa, Ontario, Canada. Formerly Aeronautical Engineer in Charge of Instrument Development, Royal Canadian Air Force. Mammalogy, Mathematics, Statistics, Biology.

MacMULLAN, RALPH A., Michigan Conservation Department, Lansing, Michigan. In charge, Game Research. Ornithology.

MALEK, JIRI, Obstetric and Gynecologic Clinic, Charles University, Prague 2, Apolinarska, Czechoslovakia. University Lecturer, Decent of Obstetrics and Gynecology. Medicine.

MALM, MIGNON, 12 Princeton Avenue, Princeton, New Jersey.

MARTIN, G. J., 372 West Johnson Street, Philadelphia. Pennsylvania.

MAXCY, KENNETH FULLER, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Maryland. Professor of Bacteriology. Bacteriology.

MAYALL, MARGARET W., The American Association of Variable Star Observers, Harvard College Observatory, Cambridge, Massachusetts. Director. Astronomy, Astrophysics.

McCABE, ROBERT A., Department of Forestry and Wildlife Management, University of Wisconsin, Madison, Wisconsin. Chairman. Mammalogy, Ornithology.

McDOUGALL, E. HUGH, Clos Dimanche, La Moye, Jersey, Channel Islands, England. Economics.

McEWEN, GEORGE FRANCIS, Scripps Institution, University of California, La Jolla, California. Formerly Professor of Physical Oceanography. Hydrology, Mathematics, Statistics, Oceanography.

McNISH, ALVIN GREENE, National Bureau of Standards, Washington, D. C. Chief, Metrology Division, Astronomy, Astrophysics, Geomagnetism, Geophysics.

MEDCOF, J. CARL., Fisheries Research Board of Canada, Biological Station, St. Andrews, New Brunswick. Head, Molluscan Shellfish Investigation. Icthyology, Limnology.

MENAKER, MICHAEL, Biological Laboratories, Harvard University, Cambridge, Massachusetts. Zoology.

MENAKER, WALTER, 898 Fairmount Place, New York, New York. Zoology.

MENZEL, WERNER, Amalie Sieveking Krankenhaus, Wiesenkamp 24, Hamburg-Volksdorf, Germany. Physiology.

MILLER, ALDEN H., University of California, Berkeley, California. Professor of Zoology.

MILLS, FREDERICK CECIL, Columbia University, New York, New York. Professor of Economics, Emeritus. Economics.

MOLDAVER, J., The Neurological Institute, New York, New York. Professor.

MOLHOLM, H., Biochemical Research Laboratory, Columbus State Hospital, Columbus, Ohio. Director.

MORGENSTERN, OSKAR, Princeton University, Princeton, New Jersey. Professor of Political Economy. Economics, Mathematics, Statistics.

MOTTLEY, CHARLES MCCAMMON, Cornell University, Ithaca, New York. Associate Professor of Limnology and Fisheries. Zoology.

MUNNS, EDWARD NORFOLK, Fibidion Gotrdy Influences, Forest Service, Washington, D. C. Forestry.

MURPHY, ROBERT C., American Museum of Natural History, New York, New York. Ornithology.

MUSHAM, H. A., Chicago 11, Illinois, Naval Architect, Professional Engineer. Meteorology, Climatology, Astronomy, Astrophysics, Geophysics, History, Hydrology, Oceanography.

MYERS, HUGH IRVIN, University of Kansas City, Kansas City, Missouri. Professor of Histology and Pathology, Director, Research and Graduate Studies. Economics.

N

NALBANDOV, A. V., Department of Animal Physiology, University of Illinois, Urbana, Illinois. Genetics.

NANCE, GORDON BENNETT, University of Missouri, Columbia, Missouri. Extension Professor. Economics.

NEAVE, FERRIS, Fisheries Research Board of Canada, Biological Station, Nanaimo, B. C., Canada. Limnology.

NELSON, JOHN H., RCA Communications, Incorporated, 44 Beaver Street, New York, New York. Propagation Analyst. Geomagnetism.

NEWBURY, FRANK DAVIS, National Series, Investment Trust, New York, New York. Consultant and Director. Economics.

NICHOLS, ROBERT LESLIE, Tufts College, Medford, Massachusetts. Volcanology.

NICHOLSON, SETH BARNES, Mt. Wilson and Palomar Observatory, Pasadena, California. Astronomer. Astronomy.

NOURSE, EDWIN GRISWOLD, 1785 Massachusetts Avenue, N.W., Washington, D. C. Economist. Economics.

O

O'CONNER, JOHN LAWRENCE, Solar Physics Division, Dominion Observatory, Ottawa, Ontario, Canada. Astronomer. Astronomy, Astrophysics.

OGBURN, WILLIAM FIELDING, 1661 Crescent Place, N.W., Washinton, D. C. Sociology.

P

PALMGREN, PONTUS, University of Helsingfore, Finland. Professor of Zoology. Zoology.

PARK, ORLANDO, Department of Biological Science, Northwestern University, Evanston, Illinois. Ecology.

PARK, THOMAS, University of Chicago, Chicago, Illinois. Professor of Zoology. Zoology.

PARKER, JOHN ROBERT, Agricultural Research Service, U. S. Department of Agriculture, Bozeman, Montana. Formerly Entomologist in Charge of Grasshopper Research. Entomology.

PEARSON, FRANK ASHMORE, Cornell University, Ithaca, New York. Professor of Agricultural Economics. Economics.

PEARSON, JOHN E., North Texas State College, Denton, Texas. Associate Professor of Statistics and Chairman, Division of Business Administration. Mathematics, Statistics.

PETERSON, R. L., Division of Mammals, Royal Ontario Museum of Zoology, Toronto, Ontario, Canada. Curator. Mammalogy.

PETT, LIONEL BRADLEY, Department of National Health and Welfare, Ottawa, Ontario, Canada. Biology.

PIERSON, WILLARD J., JR., New York University, College of Engineering, New York, New York. Associate Professor of Meteorology. Statistics.

PINCUS, GREGORY, Worcester Foundation for Experimental Biology, Shrewbury, Massachusetts. Research Director, Physiology.

PITTENDRIGH, COLIN S., Princeton University, Princeton, New Jersey. Associate Professor, Department of Biology. Biology.

PREBBLE, MALCOM LAWRENCE, Forest Insect Laboratory, Saulte Ste. Marie, Ontario, Canada. Entomology.

PRICE, CHARLES ALEXANDER, Department of Mines and Technical Services, Ottawa, Ontario, Canada. Geophysics.

Q

QUARRINGTON, B. J., Center for Advanced Study in the Behavioral Sciences, Junipero Serra Boulevard, Stanford, California.

R

RAINEY, FROELICH GLADSTONE, University Museum, Philadelphia, Pennsylvania. Anthropology.

RALPH, CHARLES L., Department of Biology, University of Pittsburgh, Pittsburgh, Pennsylvania. Zoology.

RAVITZ, LEONARD J., JR., Department of Neuropsychiatry, Duke University School of Medicine, Durham, North Carolina. Physiology.

RAWSON, KENNETH S., Department of Biology, Swarthmore College, Swarthmore, Pennsylvania. Zoology.

REIMANN, HOBART ANSTETH, Hahnemann Medical College, Philadelphia, Pennsylvania. Professor of Medicine.

REIS, R. H., Department of Biology, Marquette University, Milwaukee, Wisconsin. Director.

RICE, STUART ARTHUR, Stuart Rice Associates, Incorporated, Washington, D. C. President. Mathematics, Statistics, Sociology.

RICH, WILLIS HORTON, Stanford University, Stanford, California. Professor Emeritus of Biology. Biology.

RICHARDS, OSCAR W., American Optical Company, Southbridge, Massachusetts. Chief Biologist.

RICHARDSON, ROBERT SHIRLEY, Mt. Wilson and Palomar Observatories, Carnegie Institution, Pasadena, California. Assistant Astronomer. Astronomy.

RICHTER, CURT P., Johns Hopkins Hospital, Baltimore, Maryland. Psychology, Medicine.

RICKER, WILLIAM EDWIN, Fisheries Research Board of Canada, Pacific Biological Station, Nanaimo, British Columbia, Canada. Editor and Biologist. Ichthyology.

ROBERTS, SHEPHERD K., Department of Biology, Princeton University, Princeton, New Jersey. Zoology.

ROBERTS, WALTER ORR, High Altitude Observatory, Boulder, Colorado. Director. Astronomy.

ROBERTSON, DENNIS HOLME, University of Cambridge, Cambridge, England. Economics.

ROUNTREE, G. MEREDITH, Canadian Pacific Railway Company, Montreal, Quebec, Canada. General Auditor. Economics.

RUGH, ROBERTS, College of Physicians and Surgeons, Columbia University, New York, New York. Associate Professor of Radiology. Biology, Zoology.

RUSH, JOSEPH H., Boulder, Colorado, Consulting Physicist and Science Writer. Geomagnetism.

RUSSENHOLT, E. E., Wheat Pool Building, Winnipeg, Canada. Ornithology.

RUTHERFORD, H. K., 1869 Wyoming Avenue, Washington, D. C. Economics.

S

SAMPSON, ARTHUR WILLIAM, University of California, Berkeley, California. Forestry.

SANDEEN, MURIEL I., Department of Zoology, Duke University, Durham, North Carolina. Zoology.

SARGENT, FREDERICK, II., Department of Physiology, University of Illinois, Urbana, Illinois. Medicine.

SAUER, FRANZ, Department of Zoology, University of Wisconsin, Madison, Wisconsin. Zoology.

SCHAEFER, K. E., Physiology Branch, U. S. Naval Medical Research Laboratory, U. S. Naval Submarine Base, New London, Connecticut.

SCHMITT, O., University of Minnesota, Minneapolis, Minnesota. Professor of Physics and Zoology. Zoology.

SCHOVE, DEREK JUSTIN, St. David's College, Beckenham, Kent, England. Principal. Archaeology, Astronomy, Dendrochronology, Economics, Geology, Geomagnetism, Geophysics, History, Hydrology, Meteorology, Climatology.

SCHWALL, HENRY, Shell Oil Company, New York, New York, Economics.

SCHWASSMANN, HORST O., Department of Zoology, University of Wisconsin, Madison, Wisconsin. Zoology.

SEARS, PAUL BIGELOW, Yale University, New Haven, Connecticut. Formerly Professor of Conservationl Botany.

SEGAL, EARL, Department of Biology, Kansas State Teachers College, Emporia, Kansas. Zoology.

SELBACH, HELMUT, der Free University Berlin (Germany), Ulmen-Allee 3a Berlin-Charlottenburg 9, German-West, Direktor der Psychiatrischen und Neurologischen Klinik. Neurology and Psychiatry, Vegetative System.

SELF, STANLEY A., School of Business Administration, North Texas State College, Denton, Texas. Associate Professor of Management. Statistics.

SELFORD, VICTOR ERNEST, University of Illinois, Urbana, Illinois. Astronomy, Zoology.

SERFLING, ROBERT ELTON, Epidemiology Branch, Communicable Disease Center, Public Health Service, Atlanta, Georgia. Chief, Statistics Section. Medicine.

SHACKLEFORD, MARTHA WHEATLY, Oklahoma College for Women, Chickasha, Oklahoma. Professor of Biology. Entomology.

SHAFFNER, FELIX IRA, George Washington University, Washington, D. C. Professional Lecturer in Business Administration. Economics, Mathematics, Statistics.

SHAPIRO, ARTHUR, Sleep Research Laboratory, New York State University, Brooklyn, New York. Associate Professor of Medicine. Physiology.

SHEPHERD, GEOFFREY SEDDON, Iowa State University, Iowa City, Iowa. Professor of Economics. Economics.

SHIRK, GERTRUDE, Foundation for the Study of Cycles, 680 West End Avenue, New York 25, New York. Editor, *Cycles*. Economics.

SIIVONEN, LAURI, University of Oulu, Oulu, Finland. Professor of Zoology. Mammalogy, Ornithology, Zoology.

SIROHI, G. S., Department of Botany, University of California, Los Angeles, California. Botany.

SMITH, EDGAR LAWRENCE, 786 Mancill Road, Wayne, Pennsylvania. Investment Manager, (Retired). Economics.

SMITH, MORDEN WHITNEY, Fisheries Research Board of Canada, St. Andrews, N. B., Canada. Senior Scientist in Charge of Trout Investigation. Ichthyology, Zoology.

SNYDER, LESTER LYNNE, Department of Birds, Royal Ontario Museum of Zoology, Toronto, Ontario, Canada. Curator. Ornithology.

SOLLBERGER, ARNE, Department of Anatomy, Caroline Institute, Stockholm, Sweden. Secretary. Medicine, Biology, Zoology, Statistics.

SOROKIN, PITIRIM ALEXANDROVITCH, Winchester, Massachusetts. Director of Research Center in Creative Altruism. History, Psychology, Sociology.

SPEIRS, JOHN MURRAY, Department of Zoology, University of Toronto, Toronto, Ontario, Canada. Bibliographer and Instructor. Ornithology.

SPURR, WILLIAM ALFRED, Graduate School of Business, Stanford University, Stanford, California. Statistics.

STARK, LAWRENCE, Massachusetts Institute of Technology, Cambridge, Massachusetts. Head of Neurology Section. Neurological Servomechanisms, Hippus.

STEPHENS, GROVER C., Department of Zoology, University of Minnesota, Minneapolis, Minnesota. Zoology.

STERNE, THEODORE EUGENE, 60 Garden Street, Cambridge, Massachusetts. Astrophysics.

STETSON, HARLAN TRUE, Ft. Lauderdale, Florida. Formerly, Massachusetts Institute of Technology, Cambridge, Massachusetts. Cosmic Terrestrial Research. Astronomy, Astrophysics.

STEWART, JOHN QUINCY, Department of Astronomy, Princeton University, Princeton, New Jersey. Associate Professor of Astronomical Physics. Astrophysics.

STOREHOUSE, BERNARD, Edward Gray Institute, Botanic Gorden, Oxford, England.

STRIEFF, ABRAHAM, 425 Riverside Drive, New York, New York. Climatology, Mathematics.

SUCKLING, P., State University of New York, Brooklyn, New York. Associate Professor of Physiology. Physiology.

SWAINE, JAMES MALCOLM, Science Service, Dominion Department of Agriculture, Ottawa, Ontario, Canada. Director. Agronomy.

T

TAUSSKY, HERTHA H., Institute for Muscle Diseases, Incorporated, New York, New York.

TCHIJEVSKY, A. L., Moscow, K-9, Kalinin Str. 14, USSR. Member of the Scientific-Technical Section of the Union of Soviet Societies for Friendship and Cultural Relations with Foreign Countries. History.

TENNY, A. M., Department of Mental Hygiene, Rockland State Hospital, Orangeburg, New York.

TESTER, ALBERT LOUIS, University of Hawaii, Honolulu, T. H. Senior Professor of Zoology. Biology.

THOMAS, MORLEY K., Climatology Division, Meteorological Service of Canada, Toronto, Ontario, Canada. Deputy Chief. Meteorology, Climatology.

THOMPSON, WILLIAM ROBERT, Wesleyan University, Middletown, Connecticut. Professor of Psychology. Psychology.

THOMSON, ANDREW, Meteorological Service of Canada, Toronto, Ontario, Canada. Climatology.

THORN, WILLIAM ALBERT, Government of Canada, Toronto, Ontario, Canada. Retired Meteorologist, Meteorology. Climatology.

TUKEY, JOHN W., Bell Telephone Laboratories, Princeton, New Jersey. Mathematics, Statistics.

U

UTIDA, SYUNRO, Kyoto University, Japan. Professor of Entomology.

V

VAN OOSTEN, JOHN, University Museums Building, Ann Arbor, Michigan, Fisheries Research Biologist. Ichthyology, Limnology.

VESTINE, E. H., Department of Terrestrial Magnetism, Carnegie Institution of Washington, Washington, D. C. Geomagnetism.

VISHER, STEPHEN SARGENT, Indiana University, Bloomington, Indiana. Professor of Geography. Geology, Hydrology, Meteorology, Climatology.

VOGT, WILLIAM, Planned Parenthood Federation of America, New York, New York. National Director. Ornithology.

W

WALLACE, HENRY AGARD, Agricultural Economics, South Salem, New York. Economics.

WATSON, FLETCHER GERARD, Graduate School of Education, Harvard University, Cambridge, Massachusetts. Astronomy, Astrophysics.

WEBSTER, JOHN HENRY DOUGLAS, Meyerstein Institute of Radiotheraphy, London, England. Honarary Director. Medicine, Psychology.

WEGEL, RAYMOND LESTER, RFD 3, Peekskill, New York. Mathematics, Statistics.

WEIGHTMAN, RICHARD HANSON, 5914 Wisconsin Avenue, Chevy Chase, Maryland. Meteorology.

WELDON, JAMES M., North Atlantic Radio Service, U.S. Department of Commerce, Ft. Belvior, Virginia.

WELSH, JOHN HENRY, Harvard University, Cambridge, Massachusetts. Professor of Zoology. Biology, Oceanography, Zoology.

WENT, F. W., Missouri Botanical Garden, St. Louis, Missouri. Botany.

WEST, S. S., University of Michigan, Ann Arbor, Michigan. Sociology, History.

WEXLER, HARRY, U. S. Weather Bureau, Washington, D. C. Director of Research.

WEZLER, KARL, University of Frankfurt/Main, Frankfurt/Main, Germany. Professor of Physiology. Biology, Medicine, Meteorology.

WIENER, NORBERT, Massachusetts Institute of Technology, Cambridge, Massachusetts, Department of Mathematics. Mathematics, Statistics.

WILDER, J., 1150 Fifth Avenue, New York, New York. Medicine.

WILLARD, BRADFORD, Department of Geology, Lehigh University, Bethlehem, Pennsylvania. Professor Emeritus of Geology.

WILLETT, HURD C., Massachusetts Institute of Technology, Cambridge, Massachusetts. Professor of Meteorology. Meteorology, Climatology.

WILLEY, CHARLES HERBERT, Department of Biology, New York University, New York, New York. Professor and Chairman. Biology, Parasitology.

WILLIAMS, DAVID, Consolidated Edison Company of New York, Incorporated, New York, New York. Manager, Cable Bureau. Astronomy, Astrophysics, Economics, Geomagnetism, Meteorology, Climatology.

WILSON, EDWIN B., Harvard School of Public Health, Harvard University, Cambridge, Massachusetts. Professor of Vital Statistics. Mathematics.

WILSON, W. O., Department of Poultry Husbandry, College of Agriculture, University of California, David, California.

WING, LEONARD WILLIAM, Foundation for the Study of Cycles, Ann Arbor, Michigan. Research Associate. Biology, Climatology.

WISBY, WARREN, The Marine Laboratory, University of Miami, Miami, Florida. Zoology.

WITHROW, ALICE PHILLIPS, National Science Foundation, Washington, D. C. Assistant Program Director, Special Projects Science Education. Biology, Botany.

WOLF, W., New York University, New York, New York.

WOLFE, HECTOR H., 1151 New Jersey Avenue, Washington, D. C. Astronomy, Astrophysics.

WOLFSON, ALBERT, Department of Biological Sciences, Northwestern University, Evanston, Illinois. Zoology.

WOLMAN, LEO, 993 Park Avenue, New York, New York. Economics.

WOOD, SYDNEY MAKEPEACE, Groveland, Florida. Astronomy, Astrophysics, Hydrology.

WOODBURY, MAX, New York University, New York, New York. Professor of Statistics. Statistics.

WRIGHT, HERBERT E., JR., University of Minnesota, Minneapolis, Minnesota. Associate Professor of Geology.

WRIGHT, JAMES GODWIN, Dominion Forest Station, Ottawa, Ontario, Canada. Chief of Forest Fire Research. Forestry.

WYLIE, CHARLES CLAYTON, University of Iowa, Iowa City, Iowa. Formerly Professor of Astronomy, Astronomy, Astrophysics.

WYNNE-EDWARDS, VERO COPNER, Marischal College, University of Aberdeen, Aberdeen, Scotland. Ornithology.

Y

YARWOOD, CECIL E., University of California, Berkeley, California. Professor of Plant Pathology. Botany.

YEATMAN, W. C., 501 Financial Center Building, Los Angeles, California. Statistics.

YOCOM, CHARLES FREDERICK, Division of Natural Resources, Humboldt State College, Arcata, California. Professor and Coordinator of Wildlife Management.

YOUNG, AGNES BROOKS, 1185 Park Avenue, New York, New York. Sociology.

YULE, GEORGE UDNY, St. John's College, Cambridge, England. Mathematics.

Z

ZEUNER, FREDERICK EVERARD, University of London, London, England. Professor of Environmental Archaeology. Archaeology, Dendrochronology, Geology.

TESTING CYCLES FOR STATISTICAL SIGNIFICANCE

Applying the Bartels Test of Significance to a Time Series Cycle Analysis

by Charles E. Armstrong

In the cycle analysis of time series, the question almost invariably arises as to whether or not a given period shows statistical evidence of reality. Among the various devices used in testing for significance, Bartels' technique seems to give perhaps the most reasonable results. This test of significance, when applied to the cycle analysis of time series, reflects the degree to which a particular periodicity is consistently present throughout the series under study, as well as the persistence of the cycle, i.e., the number of waves contained in the series. In this test the cycle curve for the given period under test is fitted to the entire series, and the amplitude of the resulting measured cycle is compared with the amplitude which might be expected to occur as a result of chance factors alone. This expected amplitude is determined by fitting the cycle curve for the given period separately to successive segments of the series, each segment being one period in length. From the n individual amplitudes so obtained, an estimate of the expected average amplitude is computed in accordance with the rule used in determining the dispersion of the mean, i.e., by dividing the quadratic mean of the individual amplitudes by $\sqrt{n}$. By comparing the measured average amplitude as obtained by fitting the cycle curve to the entire series with the expected average amplitude, we have a direct means, through the use of standard probability formulae, of arriving at a mathematical measure of the genuineness of the observed cycle. As will be seen, the resulting measure of genuineness will be high in cases where individual cycles exhibit stability in both amplitude and timing, and low where the opposite conditions obtain. Also, the value of n, the number of individual periods contained in the series, has a positive effect on this measure. Of course, for $n=1$ the test is meaningless.

Since periods other than the particular one under analysis affect both the measured and expected average amplitudes in the same way and to the same degree, the final measure of genuineness is not affected by such disturbing elements. Likewise, the effects of any serial correlation present in the series is nullified by appearing in both sides of the ratio of measured to expected amplitude. Hence, the test may with safety be applied to series of deviations from moving averages or from other trend or smoothing curve devices, the use of which may change the amount of serial correlation present in the series.

The Bartels test is not designed primarily as a means of locating the periods of cycles present in a series. Its chief value lies in its application as a test of significance after the period has been located by some other means. However, in the process of locating the exact period, it is often possible to set up the work processes and papers in such a way as to facilitate the application of the Bartels test after the period has been determined. The following tables and chart illustrate the application of the test to the results of a harmonic analysis of a typical economic series.

---

*Originally published as Publication No 12 of the Foundation for the Study of Cycles.

Table I shows the initial and final portions of a monthly series of relative deviations from trend of an index of economic activity in the United States, from 1899 to 1939, inclusive. Investigation has indicated the presence in this series of a fairly marked cycle closely approximating 41 months in duration. The problem is to apply the Bartels test to this cycle as isolated by methods of harmonic analysis, and so to evaluate the probability that it could be the result of chance conformations in the data.

The first step is to break up the entire series into segments each 41 months in length. Each of these segments, of which there are twelve, is subjected to a standard harmonic analysis for a 41-month period. The method of doing this, for the first and twelfth segments, is shown on Table II.[1] For each of the twelve analyses, the constants A and B are computed as described in Table II, and the twelve sets of values so derived, together with their averages and the sums of their squares, are tabulated in Table III.

Chart I[2] is a scatter diagram depicting the tendency of the twelve sets of A and B values to cluster about their average values. Each pair of A and B values determines a point "p" on the chart. The twelve sets thus determine twelve points, p_1, p_2, p_3, ... p_{12}, and the average values determine point "P". The vector Op_1 describes the phase and amplitude[3] of the sinusoid fitted by means of harmonic analysis to the first segment of the series, the vector Op_2 represents that fitted to the second segment, and so on. Vector OP is the average of the twelve individual vectors, and represents the result of fitting a single 41-month sinusoid to the entire series. The degree to which the individual points p_1, p_2, p_3, ... P_{12} cluster about P as contrasted to about O is, according to this significance test, indicative of the probable statistical genuineness of the 41-month cycle in this series.

TABLE I

AN INDEX OF ECONOMIC ACTIVITY IN THE UNITED STATES

PERCENTAGE DEVIATIONS FROM TREND

(INITIAL AND FINAL PORTIONS ONLY)

INITIAL PORTION

	1899	1900	1901
JANUARY	- 1.8	- 0.4	- 4 3
FEBRUARY	- 2.8	- 1.7	- 1.2
MARCH	- 0 2	- 3.0	+ 0 2
APRIL	+ 0 2	- 3.8	+ 4 1
MAY	+ 2.4	- 4.9	+ 6.2
JUNE	+ 2 8	- 9.1	+ 6.5
JULY	+ 4.1	-10.2	+ 7.2
AUGUST	+ 3.8	-11.6	+ 5.0
SEPTEMBER	+ 3.4	-11.2	+ 4.2
OCTOBER	+ 3.4	-10.7	+ 1.7
NOVEMBER	+ 1.4	-10.3	+ 1 8
DECEMBER	+ 3.8	- 7.1	- 0 2

FINAL PORTION

	1937	1938	1939
JANUARY	+ 1.4	-28.6	-12.3
FEBRUARY	+ 3.3	-26.9	-11 3
MARCH	+ 5.1	-26.5	-10.5
APRIL	+ 6.0	-27.7	-13.0
MAY	+ 6.5	-28 1	-13.0
JUNE	+ 3 4	-27.9	-10.2
JULY	+ 2.6	-23.4	- 9.8
AUGUST	+ 0.6	-19.7	- 7 8
SEPTEMBER	- 3.0	-17.8	- 2.3
OCTOBER	-14.2	-16.8	+ 3 8
NOVEMBER	-24.3	-12.5	+ 6.0
DECEMBER	-29.9	-13.4	+ 6.2

As shown by Table III, the average vector OP has an amplitude of 133.49, and the quadratic mean of the amplitudes of the twelve individual vectors is 203.49. If we assume that there is no real 41-month periodicity in the data under study, and that, therefore, the apparent cyclical movements are the result of chance alone, then the twelve p-points must be considered as random selections from a field of such points distributed about and centered at O. Moreover, if the condition is purely random, the dispersion of all the points in the field about O should not be greatly different from the dispersion of the twelve selected points about O. Under such conditions, the expected amplitude of the single sinusoid fitted to the entire series may be computed as $203.49 \div \sqrt{12} = 58.74$, as contrasted to the measured amplitude to its expectancy is $133.49 \div 58.74 = 2.27$. The probability that this occurs as the result of chance alone is $\frac{1}{e^{(2.27)^2}} = \frac{1}{185}$, where e is the base of natural logarithms.[4]

The illustrative example given here is based on harmonic analysis, but the Bartels test may be applied to the results of other methods of cycle determination, as

TABLE II

41-MONTH HARMONIC ANALYSES OF FIRST AND TWELFTH SEGMENTS OF SERIES

(a)	(b) θ*	(c)	(d)	(e) 1st Segment			(f) 12th Segment		
Month	(a ÷ 41)	Sin. θ	Cos. θ	Y#	Y Sin.θ	Y Cos.θ	Y #	Y Sin.θ	Y Cos.θ
1	2.44%	0.153	0.988	-1.8	-.28	-1.78	-6.1	-.93	-6.03
2	4.88	.302	.953	-2.8	-.85	-2.67	-3.7	-1.12	-3.53
3	7.32	.444	.896	-0.2	-.09	-0.18	-3.5	-1.55	-3.14
4	9.76	.576	.817	+0.2	+.12	+0.16	-1.7	-.98	-1.39
5	12.20	.694	.720	+2.4	+1.67	+1.73	+2.2	+1.53	+1.58
6	14.63	.795	.606	+2.8	+2.23	+1.70	+1.4	+1.11	+.85
7	17.07	.878	.478	+4.1	+3.60	+1.96	+3.3	+2.90	+1.58
8	19.51	.941	.338	+3.8	+3.58	+1.28	+5.1	+4.80	+1.72
9	21.95	.982	.190	+3.4	+3.34	+0.65	+6.0	+5.89	+1.14
10	24.39	.999	.039	+3.4	+3.40	+0.13	+6.5	+6.49	+.25
11	26.83	.994	-.115	+1.4	+1.39	-0.16	+3.4	+3.38	-.39
12	29.27	.964	-.265	+3.8	+3.66	-1.01	+2.6	+2.51	-.69
13	31.71	.912	-.409	-0.4	-.36	+0.16	+0.6	+.55	-.25
14	34.15	.839	-.543	-1.7	-1.43	+0.92	-3.0	-2.52	+1.63
15	36.59	.746	-.666	-3.0	-2.24	+2.00	-14.2	-10.59	+9.46
16	39.02	.636	-.771	-3.8	-2.42	+2.93	-24.3	-15.45	+18.74
17	41.46	.511	-.859	-4.9	-2.50	+4.21	-29.9	-15.28	+25.68
18	43.90	.374	-.927	-9.1	-3.40	+8.44	-28.6	-10.70	+26.51
19	46.34	.228	-.973	-10.2	-2.33	+9.92	-26.9	-6.13	+26.17
20	48.78	.076	-.997	-11.6	-.88	+11.57	-26.5	-2.01	+26.42
21	51.22	-.076	-.997	-11.2	+.85	+11.17	-27.7	+2.11	+27.62
22	53.66	-.228	-.973	-10.7	+2.44	+10.41	-28.1	+6.41	+27.34
23	56.10	-.374	-.927	-10.3	+3.85	+9.55	-27.9	+10.43	+25.86
24	58.54	-.511	-.859	-7.1	+3.63	+6.10	-23.4	+11.96	+20.10
25	60.98	-.636	-.771	-4.3	+2.73	+3.32	-19.7	+12.53	+15.19
26	63.41	-.746	-.666	-1.2	+.90	+.80	-17.8	+13.28	+11.85
27	65.85	-.839	-.543	+0.2	-.17	-.11	-16.8	+14.10	+9.12
28	68.29	-.912	-.409	+4.1	-3.74	-1.68	-12.5	+11.40	+5.11
29	70.73	-.964	-.265	+6.2	-5.98	-1.64	-13.4	+12.92	+3.55
30	73.17	-.994	-.115	+6.5	-6.46	-0.75	-12.3	+12.23	+1.41
31	75.61	-.999	.039	+7.2	-7.19	+0.28	-11.3	+11.29	-.44
32	78.05	-.982	.190	+5.0	-4.91	+0.95	-10.5	+10.31	-2.00
33	80.49	-.941	.338	+4.2	-3.95	+1.42	-13.0	+12.23	-4.39
34	82.93	-.878	.478	+1.7	-1.49	+0.81	-13.0	+11.41	-6.21
35	85.37	-.795	.606	+1.8	-1.43	+1.09	-10.2	+8.11	-6.18
36	87.80	-.694	.720	-0.2	+.14	-0.14	-9.8	+6.80	-7.06
37	90.24	-.576	.817	+1.0	-.58	+0.82	-7.8	+4.49	-6.37
38	92.68	-.444	.896	+1.7	-.75	+1.52	-2.3	+1.02	-2.06
39	95.12	-.302	.953	+2.4	-.72	+2.29	+3.8	-1.15	+3.62
40	97.56	-.153	.988	+2.2	-.34	+2.17	+6.0	-.92	+5.93
41	100.00	-	1.000	+2.6	0	+2.60	+6.2	0	+6.20
			Total		-16.96 (A)	92.94 (B)		132.86 (A)	254.50 (B)

*Expressed as Percentages of 360°

#From Table I.

well. As in the case described above, the test depends on the relationship between the amplitude of the cycle fitted to the entire series under study and the expected amplitude as derived from the individual cycles fitted to the successive segments of the series.

It should be pointed out that the Bartels test assumes that genuine periodicities tend towards fixity in both period and amplitude. For, any variations, either systematic or random, in the length of the individual cycles tend to reduce the amplitude of the cycle curve fitted to the entire series through the averaging of out-of-phase ordinates, and so to reduce the final probability that the cycle is genuine. Likewise, variations in amplitude of individual cycles increase the expected average amplitude through the use of the quadratic mean, without proportionately increasing the amplitude of the overall cycle curve, and so also reduce the computed probability of genuineness. Hence, for comparability of results, it is generally advisable to express the series, as well as its time scale, if possible, in terms which stabilize to the fullest extent logically consistent with the nature of the series, the amplitude and period of the cycle under test. In this connection, it is usually not feasible to do much with the time scale, but often a change in the form of the series itself will tend to stabilize the cyclical amplitudes involved. For example, in the case used above in illustrating the significance test, the economic data were expressed as relatives to a long-term trend line in preference to absolute deviations, inasmuch as it resulted in a more stable cycle and also because it seemed the more reasonable approach. Had absolute deviations been used, the final probability would have been of the order of $\frac{1}{165}$.

November, 1944

TABLE III

TABULATION OF RESULTS OF HARMONIC ANALYSIS OF TWELVE SEGMENTS OF SERIES

SEGMENT	A (FROM TABLE II)	B (FROM TABLE II)	$A^2 - B^2$
1	- 16.96	+ 92.94	8,925.49
2	- 11.05	+ 143.68	20,766.04
3	+ 308.14	- 29.18	95,801.73
4	+ 66.13	+ 70.25	9,308.24
5	+ 131.35	+ 115.42	30,574.60
6	+ 108.94	- 63.35	15,881.15
7	+ 236.80	+ 184.75	90,206.80
8	- 4.90	+ 110.45	12,223.21
9	- 24.97	+ 109.94	12,710 30
10	+ 321.10	+ 34.98	104,328.81
11	- 86.42	+ 79.24	13,747 39
12	+ 132.86	+ 254.50	82,422.03
TOTAL	+1,161.02	+1,103.62	496,895.79
AVERAGE	+ 96.75	+ 91.97	41.407 98

AVERAGE AMPLITUDE $= \sqrt{96.75^2 + 91.97^2} = 133\ 49$

QUADRATIC MEAN OF TWELVE INDIVIDUAL AMPLITUDES = $\sqrt{41,407.98} = 203.49$

Footnotes

[1] The values of sine and cosine used in Table II were taken from the trigonometric table shown in the Appendix. This table shows directly the values of sine Θ and cosine Θ for values of Θ expressed as percentages of 360°. It is particularly useful in harmonic analysis, as it eliminates the step of converting to degrees, minutes, and seconds, angles which are much more readily expressed in percentage form.

[2] Chart I is essentially a "harmonic dial", differing from it only in using rectangular coordinates in place of polar. The construction of the chart is useful in illustrating the implications of the test and in presenting visually the results of the test, but, in practice, the final probabilities may be determined directly from the results computed as in Table III.

[3] The distance $Op_1 = \sqrt{A_1^2 + B_1^2}$, and therefore does not equal the amplitude of the fitted sinusoid, but is a multiple of that amplitude. This amplitude "a_1" may be derived, if desired, from the equation $a_1 = \frac{2}{41}\sqrt{A_1^2 + B_1^2}$.

[4] As an alternative approach, Bartels also assumes P to be the true point center, and computes the probability that the center of the twelve points could be as far from P as O is. As compared with the method outlined above, such an approach gives an even smaller probability that the cycle is of chance origin.

CHART I

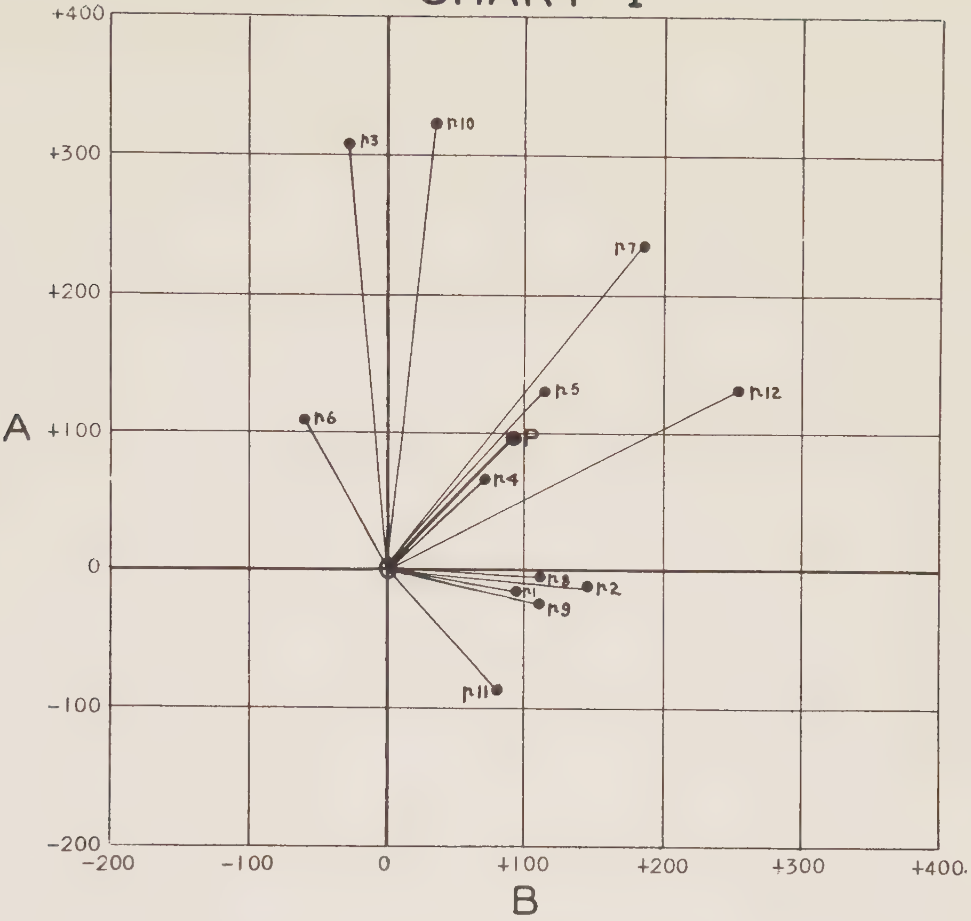

TABLE OF EXPONENTIALS

Values of e^n, From n = 1.0 to n = 10.9

(e = 2.71828)

n	.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1	2.72	3.00	3.32	3.67	4.06	4.48	4.95	5.47	6.05	6.69
2	7.39	8.17	9.02	9.97	11.0	12.2	13.5	14.9	16.4	18.2
3	20.1	22.2	24.5	27.1	30.0	33.1	36.6	40.4	44.7	49.4
4	54.6	60.3	66.7	73.7	81.4	90.0	99.5	110	122	134
5	148	164	181	200	221	245	270	299	330	365
6	403	446	493	545	602	665	735	812	898	992
7	1097	1212	1339	1480	1636	1808	1998	2208	2441	2698
8	2981	3294	3639	4024	4447	4915	5431	6003	6635	7333
9	8103	8954	9894	10940	12090	13360	14760	16320	18040	19930
10	22030	24340	26890	29740	32860	36320	40130	44360	49030	54180

A TABLE OF SINES AND COSINES OF ANGLES EXPRESSED AS PERCENTAGES OF PERIGONS

(360° = 100%)

Sin	.0	.2	.4	.6	.8	Cos
%	(All Figures Positive)					%
0	0	.012	.025	.038	.050	75
1	.063	.075	.088	.100	.113	76
2	.125	.138	.150	.163	.175	77
3	.187	.200	.212	.224	.236	78
4	.249	.261	.273	.285	.297	79
5	.309	.321	.333	.345	.356	80
6	.368	.380	.391	.403	.414	81
7	.426	.437	.448	.460	.471	82
8	.482	.493	.504	.514	.525	83
9	.536	.546	.557	.567	.578	84
10	.588	.598	.608	.618	.628	85
11	.637	.647	.656	.666	.675	86
12	.684	.694	.702	.712	.720	87
13	.729	.737	.746	.754	.762	88
14	.770	.778	.786	.794	.802	89
15	.809	.816	.823	.831	.838	90
16	.844	.851	.857	.864	.870	91
17	.876	.882	.888	.894	.899	92
18	.905	.910	.915	.920	.925	93
19	.930	.934	.939	.943	.947	94
20	.951	.955	.958	.962	.965	95
21	.968	.972	.974	.977	.980	96
22	.982	.984	.987	.989	.990	97
23	.992	.994	.995	.996	.997	98
24	.998	.999	.999	1.000	1.000	99
25	1.000	1.000	1.000	.999	.999	0
26	.998	.997	.996	.995	.994	1
27	.992	.990	.989	.987	.984	2
28	.982	.980	.977	.974	.972	3
29	.968	.965	.962	.958	.955	4
30	.951	.947	.943	.939	.934	5
31	.930	.925	.920	.915	.910	6
32	.905	.899	.894	.888	.882	7
33	.876	.870	.864	.857	.851	8
34	.844	.838	.831	.823	.816	9
35	.809	.802	.794	.786	.778	10
36	.770	.762	.754	.746	.737	11
37	.729	.720	.712	.702	.694	12
38	.684	.675	.666	.656	.647	13
39	.637	.628	.618	.608	.598	14
40	.588	.578	.567	.557	.546	15
41	.536	.525	.514	.504	.493	16
42	.432	.471	.460	.448	.437	17
43	.426	.414	.403	.391	.380	18
44	.368	.356	.345	.333	.321	19
45	.309	.297	.285	.273	.261	20
46	.249	.236	.224	.212	.200	21
47	.187	.175	.163	.150	.138	22
48	.125	.113	.100	.088	.075	23
49	.063	.050	.038	.025	.012	24

Sin	.0	.2	.4	.6	.8	Cos
%	(All Figures Negative)					%
50	0	.012	.025	.038	.050	25
51	.063	.075	.088	.100	.113	26
52	.125	.138	.150	.163	.175	27
53	.187	.200	.212	.224	.236	28
54	.249	.261	.273	.285	.297	29
55	.309	.321	.333	.345	.356	30
56	.368	.380	.391	.403	.414	31
57	.426	.437	.448	.460	.471	32
58	.482	.493	.504	.514	.525	33
59	.536	.546	.557	.567	.578	34
60	.588	.598	.608	.618	.628	35
61	.637	.647	.656	.666	.675	36
62	.684	.694	.702	.712	.720	37
63	.729	.737	.746	.754	.762	38
64	.770	.778	.786	.794	.802	39
65	.809	.816	.823	.831	.838	40
66	.844	.851	.857	.864	.870	41
67	.876	.882	.888	.894	.899	42
68	.905	.910	.915	.920	.925	43
69	.930	.934	.939	.943	.947	44
70	.951	.955	.958	.962	.965	45
71	.968	.972	.974	.977	.980	46
72	.982	.984	.987	.989	.990	47
73	.992	.994	.995	.996	.997	48
74	.998	.999	.999	1.000	1.000	49
75	1.000	1.000	1.000	.999	.999	50
76	.998	.997	.996	.995	.994	51
77	.992	.990	.989	.987	.984	52
78	.982	.980	.977	.974	.972	53
79	.968	.965	.962	.958	.955	54
80	.951	.947	.943	.939	.934	55
81	.930	.925	.920	.915	.910	56
82	.905	.899	.894	.888	.882	57
83	.876	.870	.864	.857	.851	58
84	.844	.838	.831	.823	.816	59
85	.809	.802	.794	.786	.778	60
86	.770	.762	.754	.746	.737	61
87	.729	.720	.712	.702	.694	62
88	.684	.675	.666	.656	.647	63
89	.637	.628	.618	.608	.598	64
90	.588	.578	.567	.557	.546	65
91	.536	.525	.514	.504	.493	66
92	.482	.471	.460	.448	.437	67
93	.426	.414	.403	.391	.380	68
94	.368	.356	.345	.333	.321	69
95	.309	.297	.285	.273	.261	70
96	.249	.236	.224	.212	.200	71
97	.187	.175	.163	.150	.138	72
98	.125	.113	.100	.088	.075	73
99	.063	.050	.038	.025	.012	74

C. E. ARMSTRONG

THE AVERAGE LATITUDE OF SUNSPOTS

BY EDWARD R. DEWEY

The mean weighted latitude of sunspots, North or South of the equator, 1874—1956, is approximately 14.

Mean heleographic latitudes of sunspots, by years, are conveniently available from 1874 through 1953.[1] The same figures can be computed for 1954, 1955, and 1956 from similar figures for each solar synodic rotation.[2] See Table 1.

The average of these values following the low latitude of 1878 through the low latitude of 1953 (seven cycles) is 14.04°.

This figure may be of use to students of sunspot behavior.

TABLE 1

Mean Weighted Heliographic Latitude of Sunspots, North or South of the Equator, 1874—1956

Year	Latitude	Year	Latitude	Year	Latitude	Year	Latitude
1874	10.81	1895	13.54	1916	15.81	1937	17.02
1875	11.22	1896	14.33	1917	14.63	1938	14.79
1876	11.17	1897	7.96	1918	12.75	1939	13.42
1877	9.57	1898	10.49	1919	10.76	1940	11.17
1878	7.58	1899	9.54	1920	10.43	1941	10.38
1879	21.96	1900	7.74	1921	7.90	1942	8.99
1880	19.64	1901	10.37	1922	8.02	1943	10.09
1881	18.30	1902	17.64	1923	15.26	1944	21.53
1882	17.81	1903	19.93	1924	22.73	1945	20.22
1883	13.06	1904	16.58	1925	20.20	1946	20.00
1884	11.26	1903	13.10	1926	18.66	1947	17.38
1885	11.77	1906	13.99	1927	15.05	1948	14.19
1886	10.38	1907	12.12	1928	13.50	1949	13.33
1887	8.45	1908	10.38	1929	10.51	1950	13.41
1888	7.39	1909	9.71	1930	9.87	1951	11.32
1889	11.61	1910	10.53	1931	8.31	1952	8.00
1890	21.99	1911	6.49	1932	8.32	1953	9.86
1891	20.31	1912	8.06	1933	10.56	1954	*21.16
1892	18.39	1913	23.23	1934	23.75	1955	*24.14
1893	14.47	1914	21.79	1935	23.30	1956	*21.68
1894	14.18	1915	18.77	1936	20.35		

*Average of solar rotation averages.

REFERENCES

1. *Sunspot and Geomagnetism-Storm Data,* derived from Greenwich Observation, 1874—1954, London: 1955.
2. *Greenwich Photo-Heliographic Results,* 1954, 1955, 1956.

Mr. H. A. Musham
Naval Architect
741 Rush Street
Chicago 11, Illinois